BACHELOR OF COMPUTER APPLICATIONS (BCA_NEW)

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Assignment Number: BCA (I)/111/Assignment/2024-25

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Maximum Marks: 80

Weightage: %

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Question 1: **7×4=28 Marks**

(a) What are the functions of various operational units of a computer system? What is von Neumann Architecture? How can you relate von Neumann architecture to an actual computer? Explain with the help of an example configuration.

ANS:

Functions of Various Operational Units of a Computer System

A computer system consists of several operational units, each with a specific role. These include:

1. **Central Processing Unit (CPU):** The brain of the computer, it is responsible for executing instructions from programs. The CPU has two main components:
   - **Arithmetic Logic Unit (ALU):** Performs arithmetic and logical operations (e.g., addition, subtraction, logical comparisons).
   - **Control Unit (CU):** Manages and coordinates the activities of all other components by interpreting instructions and generating control signals.
2. **Memory Unit:** Stores data and instructions that the CPU needs for processing. It is divided into:
   - **Primary Memory (RAM):** Temporary storage for data and instructions currently in use.
   - **Secondary Memory (Hard Drives, SSDs):** Permanent storage for data and applications.
3. **Input Unit:** Accepts data and instructions from external devices (e.g., keyboard, mouse) and sends them to the memory or CPU for processing.
4. **Output Unit:** Displays or outputs the processed data to external devices (e.g., monitor, printer).
5. **Storage Unit:** Responsible for storing data and instructions for long-term use, usually using hard drives, SSDs, or external storage devices.
6. **Bus:** A communication system that transfers data between various components of the computer (e.g., data bus, address bus, control bus).

von Neumann Architecture

The **von Neumann Architecture** is a design model for a computer system that describes a system where the CPU, memory, and I/O devices are interconnected and communicate via a bus system. The main characteristics of this architecture include:

1. **Single Storage:** Both data and instructions are stored in the same memory (shared memory).
2. **Sequential Execution:** Instructions are executed sequentially unless explicitly modified.
3. **Control Unit and Arithmetic Logic Unit:** The architecture has a separate control unit to fetch instructions and an ALU to execute them.
4. **Stored-Program Concept:** The instructions and data needed for processing are stored in the computer's memory.

Relation to an Actual Computer

Modern computers are built on the principles of the von Neumann architecture. For example, consider a basic configuration of a desktop computer:

- **CPU:** An Intel Core i5 processor acts as the ALU and CU.
- **RAM:** 8 GB of DDR4 memory is used as primary memory.
- **Storage:** A 512 GB SSD stores both the operating system and applications (programs).
- **Input/Output Devices:** Keyboard, mouse, and monitor serve as input and output devices, respectively.
- **Bus System:** The PCIe bus connects the CPU, memory, and storage to allow data transfer.

In this configuration, the computer stores instructions and data in RAM. The CPU fetches these instructions from RAM, decodes them in the control unit, and executes them in the ALU. The result of the execution is then stored back in memory or sent to an output device.

(b) Compare and contrast the characteristics and/or organization of the following:

(i) DRAM Vs. SRAM

(ii) Access time on Magnetic disks Vs. access time on Magnetic tapes

(iii) Pen Drive Vs. CD-RW

(iv) ROM Vs. PROM

ANS :

(i) DRAM vs. SRAM

Dynamic RAM (DRAM) and Static RAM (SRAM) are two types of memory used in computer systems, each with distinct characteristics. DRAM stores each bit of data in a separate capacitor within an integrated circuit, which requires constant refreshing to maintain the stored information. This refresh operation makes DRAM slower compared to SRAM, but it also enables a higher density of memory cells, making DRAM less expensive and capable of providing a larger storage capacity. DRAM is mainly used as the primary memory (RAM) in most computers due to its cost-effectiveness and higher capacity.

On the other hand, SRAM stores data in bistable latching circuitry (flip-flops), which does not require refreshing. This makes SRAM much faster and more power-efficient than DRAM. However, the more complex cell structure means SRAM has a lower density and is significantly more expensive to produce. Because of its speed and lower power consumption, SRAM is primarily used in smaller amounts for cache memory in CPUs, where rapid access to data is critical. In summary, DRAM is slower, cheaper, and used for larger-scale memory, while SRAM is faster, more expensive, and used where speed is essential.

(ii) Access Time on Magnetic Disks vs. Access Time on Magnetic Tapes

The access time on magnetic disks and magnetic tapes differs significantly due to their design and data retrieval methods. Magnetic disks, such as hard drives, provide fast access times, typically measured in milliseconds. This is because they allow random access to data, meaning that any piece of data can be retrieved directly by moving the read/write head to the correct position on the disk. This makes magnetic disks ideal for applications where quick data retrieval and frequent access are necessary, such as in operating systems, databases, and general-purpose storage.

In contrast, magnetic tapes, like those used in tape drives, have much slower access times, often measured in seconds or even minutes. This is due to their sequential access nature; to retrieve a specific piece of data, the tape must be wound to the correct position, which can take a considerable amount of time. However, magnetic tapes are highly suitable for backup and archival storage because they offer very high storage capacity at a low cost. They are less prone to degradation over time, making them ideal for storing large volumes of data that do not require frequent access. Thus, while magnetic disks offer speed and random access, magnetic tapes offer cost-effective, high-capacity storage but with slower access times.

(iii) Pen Drive vs. CD-RW

A pen drive (USB flash drive) and a CD-RW (Compact Disc Rewritable) are both portable storage devices but differ significantly in capacity, speed, and usability. Pen drives have much higher storage capacities, ranging from several gigabytes to terabytes, while CD-RWs typically store up to 700 MB of data. Pen drives are based on flash memory technology, allowing them to be rewritten an unlimited number of times and providing much faster data access and transfer speeds compared to CD-RWs. This makes pen drives highly suitable for frequent data transfers, portable storage, and even as bootable devices for operating systems.

CD-RWs, on the other hand, use optical technology to read and write data, which is inherently slower and less efficient than flash memory. CD-RWs can be rewritten multiple times (up to around 1,000 cycles), but they are less durable due to their susceptibility to physical damage, such as scratches and exposure to heat. CD-RWs are often used for specific purposes like backing up small amounts of data, creating audio CDs, or distributing files in a format that can be read by most CD drives. In summary, pen drives offer higher capacity, speed, and durability, while CD-RWs are slower, have lower capacity, and are more suited for limited rewritable use cases.

(iv) ROM vs. PROM

Read-Only Memory (ROM) and Programmable Read-Only Memory (PROM) are both types of non-volatile memory used to store data that must not be lost when the power is turned off. ROM is pre-programmed during manufacturing, and its contents cannot be modified afterward. This makes ROM ideal for storing firmware, BIOS, and other critical programs that are required for a computer to start up and function correctly. ROM is generally cheaper to produce due to mass production and is used in situations where data security and consistency are crucial.

In contrast, PROM is a type of ROM that can be programmed by the user after manufacturing, but only once. This one-time programmability makes PROM suitable for applications where customization is needed after the initial manufacturing, such as storing calibration data or specific configurations. However, once a PROM is programmed, it cannot be reprogrammed or modified, unlike more advanced types of programmable memory like EPROM (Erasable Programmable Read-Only Memory) or EEPROM (Electrically Erasable Programmable Read-Only Memory). PROM is slightly more expensive than standard ROM due to the need for special programming equipment. While ROM is fixed and immutable, PROM offers some flexibility for one-time programming, making it ideal for applications requiring unique data storage.

(c) Convert the following numbers as stated

(i) Decimal 64.005125 to binary

(ii) Decimal 2376 to hexadecimal

(iii) Character A and Z to ASCII and Unicode Hexadecimal CFE9A to binary

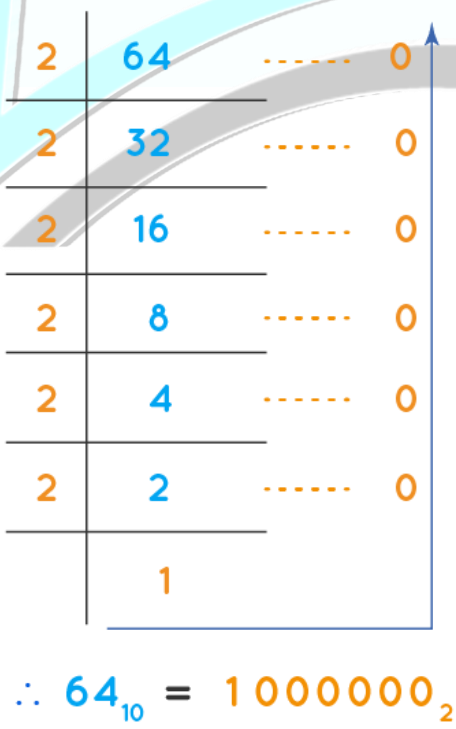
ANS:

(i) Convert Decimal 64.005125 to Binary

To convert the decimal number 64.005125 to binary, we need to convert both the integer part (64) and the fractional part (0.005125) separately:

1. Integer Part (64) to Binary:

Divide the integer part by 2 and record the remainder until the quotient becomes 0.



64 ÷ 2 = 32, remainder = 0

32 ÷ 2 = 16, remainder = 0

16 ÷ 2 = 8, remainder = 0

8 ÷ 2 = 4, remainder = 0

4 ÷ 2 = 2, remainder = 0

2 ÷ 2 = 1, remainder = 0

1 ÷ 2 = 0, remainder = 1

The binary representation is obtained by reading the remainders from bottom to top: 1000000

2. Fractional Part (0.005125) to Binary:

Multiply the fractional part by 2 and record the integer part. Repeat this until the fractional part becomes 0 or a repeating pattern is observed.

0.005125 × 2 = 0.01025 → integer part = 0

0.01025 × 2 = 0.0205 → integer part = 0

0.0205 × 2 = 0.041 → integer part = 0

0.041 × 2 = 0.082 → integer part = 0

0.082 × 2 = 0.164 → integer part = 0

0.164 × 2 = 0.328 → integer part = 0

0.328 × 2 = 0.656 → integer part = 0

0.656 × 2 = 1.312 → integer part = 1

0.312 × 2 = 0.624 → integer part = 0

0.624 × 2 = 1.248 → integer part = 1

0.248 × 2 = 0.496 → integer part = 0

0.496 × 2 = 0.992 → integer part = 0

0.992 × 2 = 1.984 → integer part = 1

0.984 × 2 = 1.968 → integer part = 1

The binary representation of the fractional part is 00000010101111... (repeating pattern).

3. Combining Both Parts:

The binary representation of **64.005125** is approximately **1000000.00000010101111**....

(ii) Convert Decimal 2376 to Hexadecimal

To convert 2376 from decimal to hexadecimal:

1. Divide the number by 16 and record the quotient and remainder.

2376 ÷ 16 = 148, remainder = 8

148 ÷ 16 = 9, remainder = 4

9 ÷ 16 = 0, remainder = 9

2. Read the remainders from bottom to top to get the hexadecimal representation: 948.

(iii) Convert Character 'A' and 'Z' to ASCII and Unicode

1. Character 'A':

ASCII: The ASCII code for 'A' is 65.

Unicode: The Unicode code for 'A' is also U+0041 in hexadecimal.

2. Character 'Z':

ASCII: The ASCII code for 'Z' is 90.

Unicode: The Unicode code for 'Z' is U+005A in hexadecimal.

(iv) Convert Unicode Hexadecimal CFE9A to Binary

To convert the Unicode hexadecimal CFE9A to binary:

1. Convert each hexadecimal digit to its 4-bit binary equivalent:

C = 1100

F = 1111

E = 1110

9 = 1001

A = 1010

2. Combine all the binary values: 11001111111010011010

(d) What is an instruction? What are its components? What is the role of an instruction in a computer? Explain with the help of an example. Where does the instruction reside at the time of execution?

ANS: An instruction is a binary-encoded command that specifies an operation for the computer's processor to execute. It is a fundamental building block of a computer program, allowing the CPU to perform tasks such as arithmetic calculations, data movement, logical operations, and control actions like branching or jumping to different parts of a program.

Components of an Instruction

1. Opcode (Operation Code): Specifies the operation to be performed (e.g., ADD, SUBTRACT, LOAD, STORE).

2. Operands: Specifies the data or the addresses of the data that the operation will be performed on. Operands can be constants, registers, or memory addresses.

3. Addressing Mode: Indicates how to interpret the operand(s), such as direct, indirect, or immediate addressing.

Role of an Instruction in a Computer

Instructions play a crucial role in controlling the CPU's operations. They provide the necessary details about what operation to perform, what data to operate on, and where to store the results. The CPU fetches each instruction from memory, decodes it to understand the required operation, executes the operation, and then stores the result. This cycle repeats continually to perform a series of tasks defined by a program.

Example of an Instruction

Consider an instruction like ADD R1, R2, R3 in a typical assembly language:

Opcode: `ADD` (tells the CPU to perform addition).

Operands: `R1`, `R2`, and `R3` (specify that the contents of registers R2 and R3 should be added, and the result should be stored in register R1).

In this example, the CPU will fetch the values stored in registers R2 and R3, add them, and store the result back in register R1.

Where Does the Instruction Reside During Execution?

At the time of execution, instructions reside in the main memory (RAM) of the computer. The CPU fetches instructions one by one from the memory, as specified by the Program Counter (PC), which holds the address of the next instruction to be executed. Once fetched, the instruction is temporarily held in the Instruction Register (IR), where it is decoded and then executed by the CPU.

This entire process is managed by the control unit, which ensures the correct sequence and synchronization of instruction execution.

(e) A 2.5 inch diameter disk has 8 platters with each platter having two data recording surfaces, each platter on disk has 4084 tracks, each track has 400 sectors and one sector can store 1 MB of data. Calculate the storage capacity of this disk in Bytes. If this disk has a seek time of 2 milli-seconds and rotates at the speed of 6000 rpm, find the Access time for the disk. Make suitable assumptions, if any.

ANS: Storage Capacity Calculation

Given:

- Disk Diameter: 2.5 inches (not directly needed for capacity calculation)
- Number of Platters: 8
- Number of Surfaces per Platter: 2 (so total surfaces = 8 * 2 = 16)
- Tracks per Surface: 4084
- Sectors per Track: 400
- Data per Sector: 1 MB

1. Calculate the Storage Capacity:

Storage per track = Number of sectors per track * Data per sector

Storage per track = 400 × 1 MB = 400 MB

Storage per surface = Number of tracks per surface * Storage per track

Storage per surface = 4084 × 400 MB = 1,633,600 MB

Total storage capacity = Number of surfaces * Storage per surface

Total storage capacity = 16 × 1,633,600 MB = 26,137,600 MB

Convert to Bytes: 26,137,600 MB × 1024 × 1024 = 27,387,432,960,000 Bytes

Total Storage Capacity = 27,387,432,960,000 Bytes

Access Time Calculation

Given:

- Seek Time: 2 milliseconds (ms)
- Rotational Speed: 6000 revolutions per minute (rpm)

1. Rotational Latency Calculation:

Time for one revolution: Time per revolution = $\frac{60\ seconds}{6000\ rpm} = 0.01\ seconds$

Average Rotational Latency = Half of one revolution

Average rotational latency = $\frac{0.01}{2} seconds = 0.005\ seconds = 5ms$

2. Total Access Time:

Access time = Seek time + Average rotational latency

Access time = 2ms + 5ms = 7m

Total Access Time = 7 milliseconds

(f) What are the uses of various components of motherboard of a computer? List at least four output devices and ports to which these devices can be connected. Explain the characteristics of these output devices and ports.

ANS: A motherboard is the main circuit board of a computer, housing the essential components that allow communication between various parts of the system. Here are some key components and their uses:

1. CPU Socket: The CPU socket holds the central processing unit (CPU), which is the brain of the computer responsible for executing instructions and processing data. The socket ensures the CPU is securely connected to the motherboard and can communicate with other components.

2. RAM Slots: These slots hold the system's memory (RAM) modules. RAM is used to store data temporarily while the computer is running, allowing for fast access to programs and files currently in use.

3. Chipset: The chipset controls data flow between the processor, memory, and peripheral devices. It is divided into two parts: the Northbridge, which handles high-speed communication between the CPU, RAM, and graphics card, and the Southbridge, which manages lower-speed connections like USB, SATA, and PCI.

4. Power Connectors: These connectors supply power from the power supply unit (PSU) to the motherboard, ensuring all components receive the necessary electricity to function.

Output Devices and Their Ports

1. Monitor:

HDMI: Supports high-definition video and audio. Commonly used for connecting monitors, TVs, and projectors.

Display-Port: Similar to HDMI but supports higher resolutions and multiple monitors from a single port.

VGA: An older analog standard that is being phased out but still found in many legacy systems.

DVI: A digital standard for older monitors supports up to 1920x1200 resolution.

2. Printer:

USB: Commonly used for direct connection to a computer, offering reliable and fast data transfer.

Wi-Fi: Allows wireless printing, ideal for shared office environments or reducing cable clutter.

Ethernet: Connects the printer to a network, enabling multiple users to access the printer over a LAN.

3. Speakers:

5mm Audio Jack: Standard for analog audio output, commonly found in laptops, desktops, and mobile devices.

USB: Digital audio connection, often with power and data over the same cable, used for powered speakers.

Bluetooth: Wireless connection allowing for portable and clutter-free audio output.

4. Projector:

HDMI: Supports high-definition video and audio, commonly used in modern projectors.

VGA: Analog connection, still used in older projectors and compatible with many legacy devices.

USB-C: Supports both video and power, becoming more common in newer projectors for a single-cable solution.

Each output device has specific ports designed to provide the best possible connection based on the device's characteristics and intended use, ensuring compatibility, quality, and ease of use in different environments.

(g) What are the uses of following Software:

(i) Data Compression Utility

(ii) Media Player

(iii) Disk Defragmenter

(iv) Disk checker

ANS:

(i) Data Compression Utility

A Data Compression Utility is a software tool used to reduce the size of files or groups of files by eliminating redundancies and encoding data more efficiently. This is particularly useful for:

Saving Storage Space: Compressing files reduces the amount of disk space they occupy, allowing for more efficient use of storage resources.

Faster Data Transfer: Smaller files require less bandwidth and time to transfer over networks or the internet, which is beneficial for uploading, downloading, or emailing files.

Archiving Files: Compression utilities are commonly used to create archives (e.g., ZIP, RAR files) containing multiple files and folders, simplifying file management and backup processes.

Encryption and Security: Some compression utilities offer encryption features, adding a layer of security by requiring a password to extract the files.

Improving System Performance: By reducing the size of files, compression utilities can help improve system performance, especially on devices with limited storage.

Examples of data compression utilities include WinRAR, 7-Zip, and WinZip.

(ii) Media Player

A Media Player is a software application used to play various types of digital media, including audio and video files. The primary uses of a media player are:

Playing Multimedia Files: Media players allow users to open, play, and manage different formats of audio and video files (e.g., MP3, MP4, AVI, MKV).

Streaming Content: Many media players support streaming online content, allowing users to watch or listen to live broadcasts, podcasts, and other streaming services.

Organizing Media Libraries: Media players often provide tools for creating and managing playlists, organizing media files by metadata (like artist, album, genre), and building personal media libraries.

Supporting Multiple Formats: They provide compatibility with various file formats, often supporting third-party codecs to extend their functionality.

Enhancing Playback Experience: Media players offer features such as subtitles, equalizers, video filters, speed control, and surround sound, improving the quality and personalization of media consumption.

Popular media players include VLC Media Player, Windows Media Player, and iTunes.

(iii) Disk Defragmenter

A Disk Defragmenter is a utility program designed to increase access speed by rearranging the data stored on a disk to occupy contiguous storage locations. Key uses include:

Improving System Performance: Defragmentation consolidates fragmented data, reducing the time required to read and write files, which can improve the overall speed and performance of the computer.

Reducing Wear and Tear: On hard disk drives (HDDs), defragmentation reduces the amount of movement the read/write heads must make, thereby extending the lifespan of the drive.

Optimizing File Storage: It organizes files and free space more efficiently, making it easier for the operating system to find and use available space.

Preventing Disk Errors: Regular defragmentation can help identify and repair potential file system errors, reducing the risk of data loss.

Faster Boot Times: By organizing system files more efficiently, a disk defragmenter can reduce the time it takes for the operating system to boot.

Disk Defragmenters are most useful for HDDs; they are less relevant for Solid State Drives (SSDs) due to their different storage technology.

(iv) Disk Checker

A Disk Checker is a utility tool that scans a storage device (such as a hard disk, SSD, or external drive) for errors, bad sectors, or file system problems. The primary uses of a disk checker include:

Detecting and Repairing Disk Errors: It scans the storage device for logical or physical errors and attempts to repair them, helping to maintain the health and integrity of the disk.

Preventing Data Loss: By identifying and fixing potential issues early, a disk checker can help prevent data corruption or loss caused by faulty sectors or file system errors.

Improving System Stability: Regular disk checks can prevent system crashes and other issues that result from disk errors, contributing to more stable and reliable system performance.

Maintaining Optimal Performance: It ensures that data is correctly stored and accessible, reducing the likelihood of performance degradation due to disk errors.

Ensuring Data Integrity: By verifying that files and file systems are intact, disk checkers help maintain data integrity and reliability over time.

Common disk checkers include CHKDSK in Windows, fsck in Linux, and Disk Utility in macOS.

Question 2: **7×4=28 Marks**

(a) Why do you need virus detection software? What are their drawbacks? What are the techniques to identify a virus? List any 4 latest virus for desktop systems.

ANS:

Need Virus Detection Software

Virus detection software, commonly known as antivirus software, is essential for the following reasons:

1. Protection Against Malware: Detects, quarantines, and removes malicious software (malware) such as viruses, worms, trojans, ransomware, and spyware that can harm the system or compromise data.

2. Data Security: Prevents unauthorized access, theft, or corruption of sensitive data by detecting and blocking malware before it can execute.

3. System Performance: Helps maintain optimal system performance by removing malware that consumes resources and causes slowdowns.

4. Preventing System Damage: Protects the operating system and critical software from being corrupted or rendered unusable by malware.

5. Mitigating Cyber Threats: Provides a line of defense against phishing attacks, identity theft, and other cyber threats that could lead to financial or personal data loss.

Drawbacks of Virus Detection Software

1. Performance Impact: Antivirus software often consumes significant system resources, potentially slowing down the computer, especially during scans or updates.

2. False Positives: Antivirus programs may incorrectly identify legitimate software as malicious, leading to unnecessary alerts and the potential blocking or removal of needed files.

3. Limited Detection Scope: Some antivirus solutions may not detect new or sophisticated malware that uses advanced evasion techniques or exploits zero-day vulnerabilities.

4. Frequent Updates Required: Regular updates are necessary to keep the virus database current; otherwise, the software may become ineffective against new threats.

5. Potential for Exploits: In rare cases, vulnerabilities in the antivirus software itself can be exploited by attackers to gain unauthorized access to the system.

Techniques to Identify a Virus

1. Signature-Based Detection: Compares the code of a suspected file to a database of known virus signatures. This method is effective for known viruses but not for new, unknown malware.

2. Heuristic Analysis: Uses algorithms to analyze the behavior of files and detect potentially malicious code based on patterns, even if they are not in the virus signature database. This helps identify new and modified malware.

3. Behavioral Analysis: Monitors the behavior of programs in real-time and flags any suspicious activity, such as unauthorized file modification or network connections. This is effective against polymorphic viruses that change their code to avoid detection.

4. Sandboxing: Runs the suspect file in a virtual environment to observe its behavior without risking the host system. If the file acts like malware, it is quarantined or deleted.

5. Machine Learning and AI: Employs machine learning algorithms to identify malware by recognizing patterns and behaviors in vast datasets. This approach can improve detection accuracy and adapt to evolving threats.

Latest Viruses for Desktop Systems

1. Raccoon Stealer v2: A new version of the malware that steals sensitive information like passwords, cookies, and banking information from infected systems.

2. Snake Keylogger: A malware that records keystrokes and captures screenshots to steal credentials and personal information.

3. BlackByte Ransomware: A ransomware strain that encrypts files on a victim's computer and demands a ransom for decryption.

4. Qbot (Qakbot) Trojan: A banking trojan that steals financial information and can deliver other malware like ransomware by creating backdoors in the infected systems.

(b) Consider that you have to run several computer programs simultaneously on a computer. Each program takes input from a file and output information on a printer. How does different components of an Operating system (like memory management, I/O management, Process management, file system and user interface) will help in execution of these programs.

ANS: When running multiple programs that each take input from a file and output to a printer, various components of the operating system (OS) work together to manage resources and ensure smooth execution. Here's how different components of the OS help:

1. Memory Management

Manages the allocation and deallocation of memory to ensure each program has the necessary resources without interfering with others. It keeps track of which parts of memory are in use and which are free.

How It Helps:

Allocates separate memory spaces (address spaces) for each program, ensuring they run without conflict.

Handles swapping and paging if the physical memory is insufficient, ensuring programs that do not fit in RAM are temporarily moved to disk storage.

Prevents memory leaks and conflicts that could lead to crashes or degraded performance.

2. I/O Management

Manages input and output operations, ensuring that data flows smoothly between devices (like printers) and programs.

How It Helps:

Uses buffers to temporarily store input and output data, managing the speed differences between the CPU and I/O devices.

Coordinates access to the printer, ensuring programs queue their print jobs without causing conflicts (spooling).

Provides drivers that allow the OS to communicate effectively with different hardware devices (e.g., printers, disk drives).

3. Process Management

Manages the creation, scheduling, execution, and termination of processes (instances of programs).

How It Helps:

Uses multitasking to allow multiple programs to run concurrently by switching between them rapidly (context switching).

Prioritizes processes using scheduling algorithms (like Round Robin, Priority Scheduling) to ensure fair allocation of CPU time.

Manages process states (e.g., ready, running, blocked) and transitions between them to keep the system responsive.

4. File System Management

Manages file operations, such as reading, writing, creating, and deleting files. It organizes files on storage devices and manages access rights.

How It Helps:

Provides a hierarchical directory structure to store and organize input files and ensure programs access the correct data.

Manages file locks to prevent multiple programs from writing to the same file simultaneously, avoiding data corruption.

Ensures data integrity and security by managing access control lists (ACLs) and permissions.

5. User Interface

Provides a means for users to interact with the computer, typically through a graphical user interface (GUI) or command-line interface (CLI).

How It Helps:

Allows users to start, stop, and manage multiple programs easily, often with visual feedback (e.g., task manager).

Provides tools and utilities for monitoring system performance, managing running processes, and adjusting system settings.

Offers accessibility features to make system navigation and program management easier for users of varying abilities.

How These Components Work Together

When several programs run simultaneously, the memory manager allocates necessary memory, while the process manager schedules CPU time and manages transitions between programs. The I/O manager handles data input from files and coordinates output to the printer, using spooling to manage print queues. Meanwhile, the file system manager ensures that all file accesses are handled correctly, preventing conflicts and maintaining data integrity. Finally, the user interface provides users with tools to manage and monitor these activities, making the interaction seamless and efficient.

Together, these components ensure that multiple programs can run efficiently, sharing resources without interference or data loss, while providing a responsive user experience.

(c) Explain the differences between procedural programming and object oriented programming with the help of one example program of each.

ANS: Procedural Programming (PP) and Object-Oriented Programming (OOP) are two fundamental programming paradigms with distinct approaches to organizing and structuring code.

Key Differences

1. Programming Approach:

PP: Focuses on functions or procedures that operate on data. The program is divided into small parts called functions.

OOP: Focuses on objects that encapsulate data and behavior. The program is divided into classes and objects.

2. Data Handling:

PP: Data is generally separated from functions and can be accessed from anywhere in the program.

OOP: Data is encapsulated within objects and accessed through methods, promoting data hiding and encapsulation.

3. Code Reusability:

PP: Code reusability is achieved through function calls; functions can be reused but may require extensive modification for different contexts.

OOP: Code reusability is enhanced through inheritance and polymorphism; classes can be extended, and objects can be modified without changing the core structure.

4. Modularity:

PP: The program structure is less modular; changes in one part of the program may require changes in other parts.

OOP: Highly modular, as objects can be modified independently; changes in one object do not necessarily affect others.

5. Ease of Maintenance:

PP: Maintenance can be challenging, especially for large programs, due to tight coupling between functions and global data.

OOP: Easier to maintain and extend, due to modularity and encapsulation.

Example Programs

1. Procedural Programming Example (C):

A simple C program to calculate the area of a rectangle using functions.

```
include <stdio.h>
// Function to calculate the area of a rectangle
float calculateArea(float length, float width) {
    return length * width;
}

int main() {
    float length, width, area;
    // Input length and width
    printf("Enter length of the rectangle: ");
    scanf("%f", &length);
    printf("Enter width of the rectangle: ");
    scanf("%f", &width);
    // Calculate area
    area = calculateArea(length, width);
    // Display result
    printf("Area of the rectangle: %.2f\n", area);
    return 0;
}
```

2. Object-Oriented Programming Example (C++):

A C++ program to calculate the area of a rectangle using a class.

```
include <iostream>
using namespace std;

// Class definition
class Rectangle {
private:
    float length;
    float width;
public:
    // Constructor to initialize data members
    Rectangle(float l, float w) {
        length = l;
        width = w;
    }
    // Method to calculate area
    float calculateArea() {
        return length * width;
    }
};

int main() {
    float length, width;
    // Input length and width
    cout << "Enter length of the rectangle: ";
    cin >> length;
    cout << "Enter width of the rectangle: ";
    cin >> width;
    // create an object of Rectangle class
    Rectangle rect(length, width);
    // calculate and display area
    cout << "Area of the rectangle: " << rect.calculateArea() << endl;
    return 0;
}
```

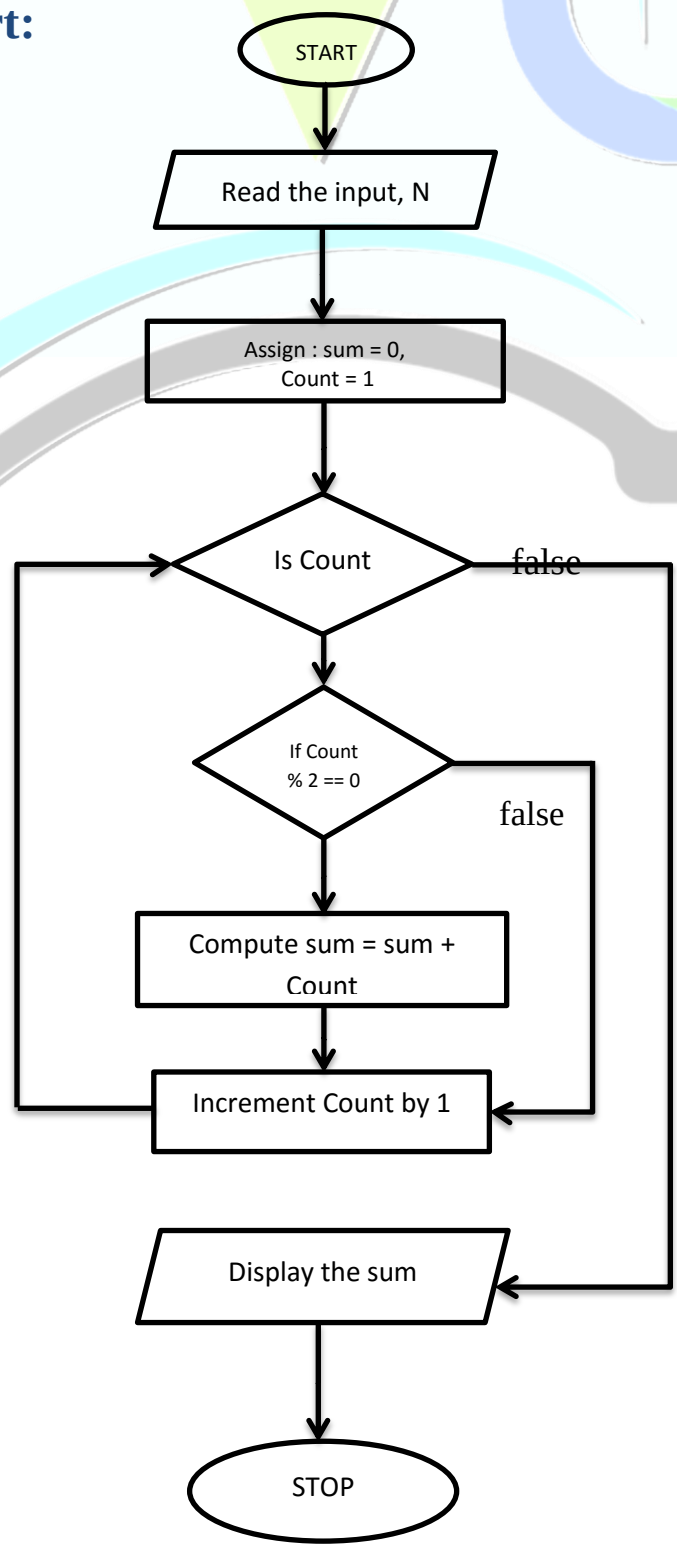
(d) Draw a flow chart of a program that adds N even numbers starting from 1. The value of N should be input by the user.

ANS:

Flowchart Steps:

1. **Start**: Begin the program.
2. **Input N**: Prompt the user to input the value of N (the number of even numbers to be added).
3. **Initialize Variables**:
   - Set Sum = 0 (to store the sum of even numbers).
   - Set Count = 1 (to keep track of how many even numbers have been added).
4. **Loop** until Count > N:
   - Check Condition: If Count <= N, proceed to the next step; otherwise, go to step 8 and check if the number is even or not.
5. **Add Even Number**:
   - Add Number to Sum (i.e., Sum = Sum + Count).
6. **Increment Variables**:
   - Increment Count by 1 (i.e., Count = Count + 1).
7. **Repeat Loop**: Go back to step 4.
8. **Display Sum**: Print the value of Sum.
9. **End**: End the program.

Flowchart:



(e) List the elements of a programming language. Explain the terms data type, expression, assignment; and logical, relational and equality operators with the help of an example each.

ANS: A programming language consists of various elements that define its syntax, structure, and logic. Key elements include:

1. **Data Types**: Categories of data that tell the compiler or interpreter how the programmer intends to use the data. Examples include integers, floating-point numbers, characters, and strings.

2. **Variables**: Named storage locations in memory that hold data and can change during program execution.

3. **Expressions**: Combinations of variables, operators, and values that produce a result.

4. **Operators**: Symbols that perform operations on operands (variables or values). Common types are arithmetic, relational, logical, and assignment operators.

5. **Control Structures**: Constructs that control the flow of execution, such as loops (`for`, `while`) and conditionals (`if`, `else`).

6. **Functions/Procedures**: Blocks of code designed to perform specific tasks and can be reused throughout the program.

7. **Comments**: Notes written in the code to explain its logic, which are ignored by the compiler/interpreter.

Explanation of Terms

1. **Data Type**: A classification specifying the type of data a variable can hold.

Example:

int represents an integer data type.

float represents a floating-point number (decimal).

Usage:

```
int age = 25;      // 'age' is an integer
float price = 9.99; // 'price' is a floating-point number
```

2. **Expression**: A combination of variables, constants, and operators that computes a value.

Example:

3 + 5 is an arithmetic expression that evaluates to 8.

Usage:

```
int sum = 5 + 3; // An arithmetic expression that computes the sum of 5 and 3.
```

3. **Assignment**: The process of assigning a value to a variable using the assignment operator =.

Example:

x = 10 assigns the value 10 to the variable x.

Usage:

```
int x;
x = 10;  // Assigns the value 10 to the variable x.
```

4. **Logical Operators**: Operators used to perform logical operations, such as AND, OR, and NOT.

Example:

&& (logical AND), || (logical OR), ! (logical NOT).

Usage:

```
if (a > 5 && b < 10) { // Logical AND operator
  printf("Condition is true.");
}
```

5. **Relational Operators**: Operators that compare two values or expressions and return a boolean value (true or false).

Example:

<, >, <=, >=.

Usage:

```
if (x < 20) { // Relational operator less than
  printf("x is less than 20.");
}
```

6. **Equality Operators**: Operators used to check if two values or expressions are equal (==) or not equal (!=).

Example:

== (equals), != (not equals).

Usage:

```
if (x == y) { // Equality operator
  printf("x is equal to y.");
}
```

(f) What are the phases of project development in which project management software can help. Explain with the help of examples.

ANS: Project management software helps manage various phases of project development, providing tools and features that facilitate planning, execution, monitoring, and completion. The phases in which project management software can assist are:

1. Initiation: Defining the project, its goals, scope, stakeholders, and deliverables.

Support by Project Management Software:

Helps document project scope, objectives, and deliverables.

Provides tools for stakeholder analysis and project charter creation.

Examples: Software like Microsoft Project or Trello can be used to outline initial project details and collaborate with stakeholders.

2. Planning: Developing a detailed project plan that includes tasks, timelines, resources, and budget.

Support by Project Management Software:

Facilitates task management by allowing the creation of task lists, assigning tasks to team members, and setting deadlines.

Provides Gantt charts, calendars, and timelines to visualize the project schedule.

Tools like Asana or Monday.com help in resource allocation, risk management, and budget tracking.

3. Execution: The phase where the actual work of the project is performed to achieve the project objectives.

Support by Project Management Software:

Enables real-time collaboration among team members, sharing of documents, and communication.

Tracks progress by monitoring task completion and updating project status.

Tools like Jira or Wrike can help in tracking progress, managing tasks, and facilitating team communication.

4. Monitoring and Controlling: Monitoring the progress of the project to ensure it stays on track, on time, and within budget.

Support by Project Management Software:

Provides dashboards and reports to monitor project performance metrics such as task completion rate, budget utilization, and time tracking.

Alerts and notifications for potential risks, delays, or deviations from the project plan.

Software like Microsoft Project or Smartsheet can be used for variance analysis, quality control, and performance reporting.

5. Closure: Finalizing all project activities, delivering the product or service, and closing the project.

Support by Project Management Software:

Facilitates documentation of lessons learned, project evaluation, and final reporting.

Manages final deliverables, contracts, and project archives.

Tools like Basecamp or Teamwork can help create project closure documents, gather feedback, and ensure all project requirements are met.

By using project management software throughout these phases, project managers can efficiently plan, execute, and deliver projects while maintaining control over resources, time, and budget.

(g) Explain the following with the help of an example/diagram, if needed:

(i) Development Model for Open Source Software

(ii) Tools for program development

(iii) Use of functions and Macros

(iv) Database and Database Management System

ANS:

(i) Development Model for Open Source Software

The development model for open source software is a collaborative approach where the source code is made publicly available. Anyone can inspect, modify, and distribute the software, fostering community-driven development and improvements.

Key Characteristics:

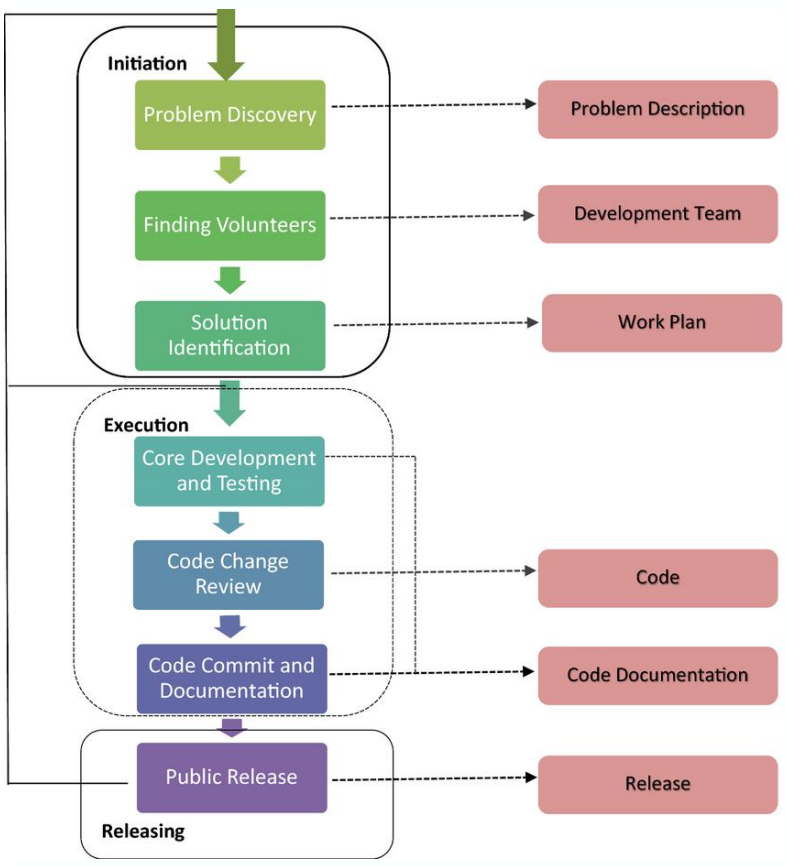
- **Transparency:** The source code is publicly accessible.

- **Collaboration:** Developers from around the world contribute to the software.

- **Peer Review:** Code is frequently reviewed and improved by the community.

- **Rapid Iteration:** Changes and updates happen frequently due to contributions from many developers.

Example Diagram:



Explanation:

1. **Initiation:** Developers from the community find the problem, contribute code, features, and bug fixes.
2. **Execution:** Core developers integrate community contributions into the main codebase.
3. **Testing and Review:** The integrated code undergoes rigorous testing and peer review.
4. **Release to Public:** After successful testing, the new version is released to the public.

(ii) Tools for Program Development

Tools for program development are software applications that aid developers in writing, testing, debugging, and managing code.

Common Tools:

1. **Integrated Development Environments (IDEs):** Provide a comprehensive suite of tools, including a code editor, debugger, and compiler. Example: Visual Studio, Eclipse.
2. **Version Control Systems (VCS):** Track changes in code and manage versions. Example: Git, Subversion.
3. **Build Tools:** Automate the process of building and packaging software. Example: Maven, Gradle.
4. **Debuggers:** Help find and fix bugs in code. Example: GDB (GNU Debugger).
5. **Text Editors:** Simple code editors for writing and editing code. Example: Notepad++, Sublime Text.

(iii) Use of Functions and Macros

1. Functions:

Reusable blocks of code that perform a specific task. Functions are defined once and can be called multiple times.

Example:

```
int add(int a, int b) {
    return a + b;
}
// Usage: add(5, 3);
```

Benefits: Reduces code redundancy, improves modularity, and simplifies maintenance.

2. Macros:

Preprocessor directives that define code snippets or constants, which are expanded by the preprocessor before compilation.

Example:

```
define PI 3.14

define SQUARE(x) ((x) * (x))

// Usage: SQUARE(5) expands to (5 * 5)
```

Benefits: Reduces code repetition and can optimize performance, but lacks the error checking and flexibility of functions.

(iv) Database and Database Management System (DBMS)

1. Database: A structured collection of data that is stored and accessed electronically.

Example: A library database containing tables for books, authors, and borrowers.

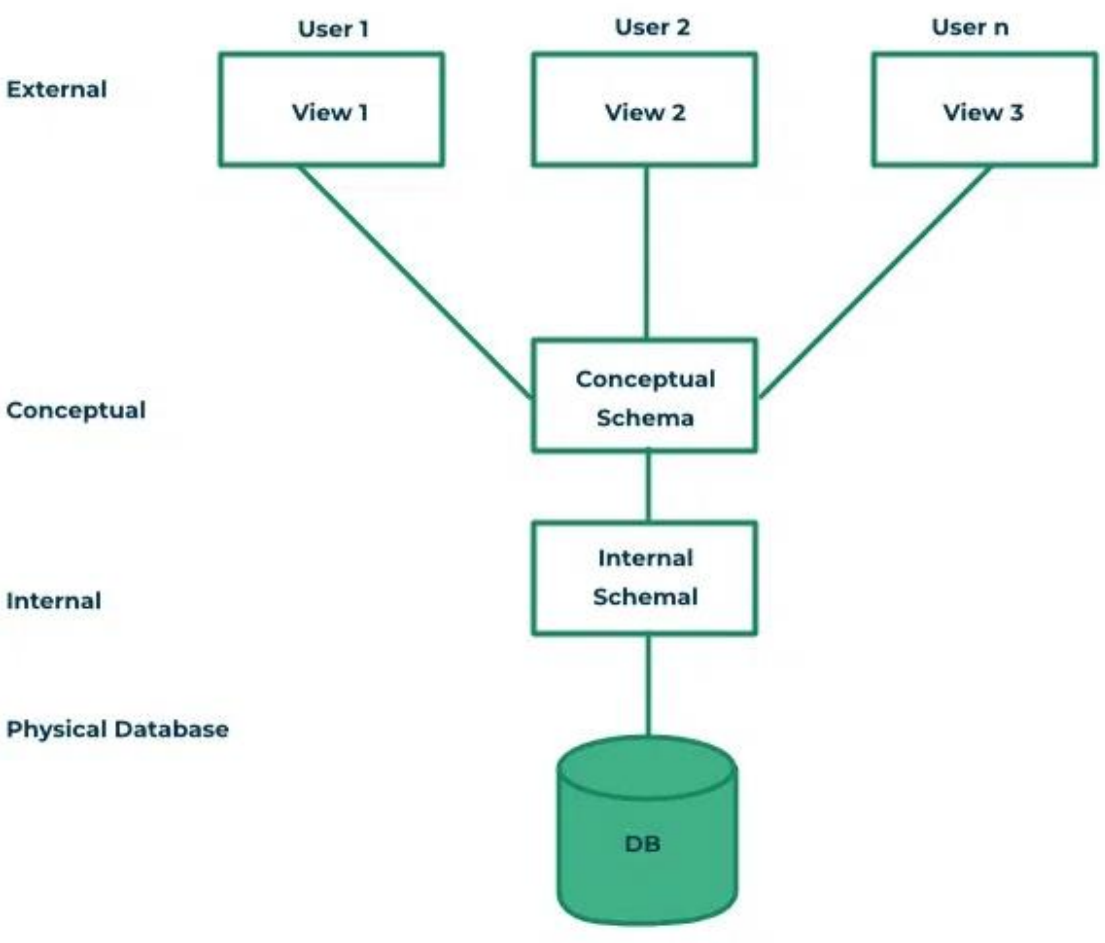
2. Database Management System (DBMS):

Software that facilitates the creation, management, and manipulation of databases.

Key Functions:

- ***Data Storage and Retrieval***: Efficiently stores and retrieves large amounts of data.
- ***Data Security:*** Provides access control and data encryption.
- ***Data Integrity:*** Ensures the accuracy and consistency of data.
- ***Concurrency Control:*** Manages multiple users accessing data simultaneously.
- ***Example DBMS:*** MySQL, Oracle, PostgreSQL.

Diagram Example:



Question 3: **6×4=24 Marks**

(a) Explain the characteristics of any two guided and any two unguided channels for data transmission.

ANS:

Guided Channels:

1. Twisted Pair Cable:

Consists of two insulated copper wires twisted together. The twisting helps reduce electromagnetic interference (EMI) from external sources and crosstalk between neighboring pairs.

Usage: Widely used in telephone networks and Ethernet LANs (Local Area Networks).

Advantages: Cost-effective, easy to install, and suitable for short to medium distance communication.

Limitations: Limited bandwidth and susceptibility to external interference if not properly shielded.

2. Fiber Optic Cable:

Composed of a core (made of glass or plastic) that carries light signals, surrounded by cladding, which reflects the light back into the core, and a protective outer layer.

Usage: Used for long-distance communication, high-speed data transfer, and in environments with high EMI.

Advantages: High bandwidth, immune to EMI, low signal attenuation, and capable of transmitting data over long distances without the need for repeaters.

Limitations: Expensive and more difficult to install and maintain compared to other guided media.

Unguided Channels:

1. Radio Waves:

Propagate through the air and are omnidirectional, meaning they can cover a large area without the need for a direct line of sight between the transmitter and receiver.

Usage: Commonly used for mobile phones, Wi-Fi, and broadcast radio and television.

Advantages: Wireless, capable of covering long distances, and suitable for mobile communication.

Limitations: Susceptible to interference from other electronic devices and environmental factors, such as weather conditions.

2. Microwave Transmission:

Characteristics: Utilizes high-frequency radio waves and requires line-of-sight between the transmitter and receiver. Signals can be transmitted over long distances by using repeaters.

Usage: Used in satellite communications, cellular networks, and point-to-point communication links.

Advantages: High bandwidth and capable of carrying large amounts of data over long distances.

Limitations: Requires line-of-sight, which can be obstructed by buildings, terrain, or weather conditions, leading to signal loss or degradation.

(b) Four branch offices of an organization are located in four major cities of a vast country. Explain the characteristics of the network that will be needed for every branch office. All the four branch offices network should also be connected by another network. Explain the characteristics of this network also.

ANS:

1. Network for Each Branch Office (Local Area Network - LAN):

Scope: Covers a small geographic area, such as a single building or campus.

Characteristics:

High Speed: Typically offers high data transfer rates (e.g., 100 Mbps to 10 Gbps) suitable for internal communication and resource sharing.

Reliability: Designed to be highly reliable with minimal downtime, often with backup systems in place.

Security: Strong security measures, such as firewalls, encryption, and access controls, are implemented to protect sensitive organizational data.

Scalability: Easy to add or remove devices, making it adaptable to the changing needs of the branch office.

Technologies Used: Ethernet, Wi-Fi, or a combination of both.

2. Network Connecting All Branch Offices (Wide Area Network - WAN):

Scope: Covers a large geographic area, connecting branch offices across cities, states, or even countries.

Characteristics:

Broad Coverage: Capable of connecting multiple LANs over long distances, often using leased lines, satellite links, or the internet.

Lower Speed Compared to LAN: Typically has lower data transfer rates than LANs, due to the greater distances involved and higher latency.

Reliability: WANs are designed to be robust and resilient, often with redundant paths to ensure continuous communication even if one link fails.

Cost: Generally more expensive to implement and maintain than a LAN, due to the need for specialized equipment and leased communication lines.

Security: Enhanced security features, such as Virtual Private Networks (VPNs) and encryption, are crucial to protect data as it travels across public and private networks.

(c) What is Internet? What are the major protocols used on Internet? What is an IP address? How can an IP address be related to a web address? Explain with the help of an example.

ANS:

Internet:

The Internet is a global network of interconnected computers and servers that communicate with each other using standardized protocols. It allows users to access and share information, resources, and services across the world.

Major Protocols Used on the Internet:

1. Transmission Control Protocol (TCP): Ensures reliable data transmission by establishing a connection between the sender and receiver, and ensuring data packets are delivered in the correct order and without errors.

2. Internet Protocol (IP): Responsible for addressing and routing packets of data so that they can travel across networks and reach the correct destination.

3. Hypertext Transfer Protocol (HTTP/HTTPS): Used for transmitting web pages over the internet. HTTPS is the secure version, providing encryption for data in transit.

4. File Transfer Protocol (FTP): Used for transferring files between computers on a network.

5. Simple Mail Transfer Protocol (SMTP): Used for sending and receiving email messages.

IP Address:

An IP address is a unique numerical label assigned to each device connected to a network that uses the Internet Protocol for communication. It serves two main functions: identifying the host or network interface and providing the location of the host in the network.

Relation Between IP Address and Web Address:

A web address (or URL) is a human-readable address used to access a website. It is mapped to an IP address, which is used by computers to locate the server hosting the website.

Example:

Web Address: www.youtube.com

IP Address: 192.0.2.1

When a user types `www.youtube.com` into their browser, a Domain Name System (DNS) server translates this web address into its corresponding IP address (`192.0.2.1`). The browser then uses this IP address to communicate with the web server hosting the website, allowing the user to access the content of the site.

(d) What are the different features of a browser? If you want to perform Online Banking Transactions, what precautions will you take before performing a transaction?

ANS:

Features of a Browser:

1. Rendering Engine: The browser's rendering engine is responsible for displaying web content, such as HTML, CSS, and JavaScript, on the screen. Popular engines include Blink (used by Chrome) and Gecko (used by Firefox).

2. Tab Management: Modern browsers allow users to open multiple websites in separate tabs within the same window, making multitasking easier.

3. Bookmarks: Users can save frequently visited websites as bookmarks for quick access.

4. Extensions and Add-ons: Browsers support various extensions or add-ons that enhance functionality, such as ad-blockers, password managers, and productivity tools.

5. Privacy Mode (Incognito/InPrivate): Browsers offer a private browsing mode that does not save browsing history, cookies, or form data.

6. Security Features: Browsers include features like SSL/TLS support for secure connections (HTTPS), pop-up blockers, and phishing protection to enhance online security.

7. Download Manager: Manages and tracks files downloaded from the internet, providing options to pause, resume, or cancel downloads.

8. Developer Tools: Built-in tools that allow web developers to inspect and debug websites, analyze performance, and view source code.

Precautions for Online Banking Transactions:

1. Use a Secure Connection: Ensure that the website uses HTTPS (indicated by a padlock icon in the address bar) to encrypt your data during transmission.

2. Verify the Website's Authenticity: Double-check the URL to make sure you are on the official banking website. Avoid clicking on links in unsolicited emails or messages.

3. Use Strong Passwords: Create a strong, unique password for your online banking account and avoid using the same password for multiple sites.

4. Enable Two-Factor Authentication (2FA): If your bank offers 2FA, enable it to add an extra layer of security to your account.

5. Avoid Public Wi-Fi: Do not perform online banking transactions on public or unsecured Wi-Fi networks, as they are more vulnerable to attacks.

6. Keep Your Browser and Security Software Updated: Ensure that your browser and antivirus software are up-to-date to protect against known vulnerabilities.

7. Log Out After the Session: Always log out of your online banking session when you're finished, especially on shared or public computers.

8. Monitor Your Account Regularly: Keep an eye on your account statements and transaction history to quickly identify and report any suspicious activity.

(e) Describe the process of creating a web email account. What are the different components of a mail message? Explain with the help of a diagram.

ANS:

Process of Creating a Web Email Account:

1. Choose an Email Provider: Select a web-based email service provider, such as Gmail, Yahoo Mail, or Outlook.

2. Visit the Provider's Website: Go to the website of the chosen email provider.

3. Sign Up for an Account:

- Click on "Sign Up" or "Create Account."
- Fill in the required information, such as your first name, last name, desired email address, and password.
- You may need to provide additional information, such as your phone number for account recovery.

4. Verify Your Identity: Some providers may require you to verify your identity by entering a code sent to your phone number or email.

5. Agree to Terms and Conditions: Review and accept the terms of service and privacy policy.

6. Complete the Setup: After filling in all necessary information and verifying your identity, your email account will be created. You can now start using your new email address.

Components of a Mail Message:

1. From: The sender's email address.

2. To: The recipient's email address(es).

3. Cc (Carbon Copy): Email addresses of additional recipients who will receive a copy of the email.

4. Bcc (Blind Carbon Copy): Email addresses of recipients who will receive a copy of the email without the other recipients knowing.

5. Subject: A brief description of the email's content or purpose.

6. Body: The main content of the email, which can include text, images, links, and attachments.

7. Attachments: Files or documents that are sent along with the email.

8. Signature: A personalized sign-off that typically includes the sender's name, title, and contact information.

(f) Explain the following in the context of Internet and its applications, giving their features and uses:

(i) Online Education

(ii) eCommerce

ANS:

(i) Online Education:

Features:

Accessibility: Allows learners to access educational content from anywhere in the world, provided they have an internet connection.

Flexible Scheduling: Students can learn at their own pace and on their own schedule, making it easier to balance education with other responsibilities.

Variety of Content: Offers a wide range of educational resources, including video lectures, e-books, quizzes, and interactive simulations.

Interactive Learning: Includes features such as discussion forums, live webinars, and virtual classrooms that enable interaction between students and instructors.

Assessment and Feedback: Provides tools for online quizzes, assignments, and automated grading systems that give instant feedback.

Uses:

Distance Learning: Enables students to pursue degrees or certifications remotely, without the need to attend a physical campus.

Skill Development: Offers online courses and tutorials for developing specific skills, such as programming, digital marketing, or language learning.

Corporate Training: Businesses use online education platforms to train employees on new technologies, compliance, or professional development.

(ii) eCommerce:

Features:

Online Shopping Cart: Allows customers to select and store items they wish to purchase before proceeding to checkout.

Payment Gateway Integration: Supports various payment methods, including credit/debit cards, digital wallets, and bank transfers.

User Accounts: Provides personalized accounts for customers to track orders, save preferences, and view purchase history.

Search and Filtering: Offers search functionality and filters to help users find specific products quickly and easily.

Product Reviews and Ratings: Enables customers to read and write reviews, helping others make informed purchasing decisions.

Uses:

Retail: Businesses sell products directly to consumers through online platforms, expanding their reach beyond physical stores.

B2B Transactions: Companies can conduct business-to-business (B2B) transactions, such as bulk purchasing, through specialized eCommerce platforms.

Digital Goods: eCommerce is used to sell digital products like e-books, software, and online subscriptions.

Marketplace: Platforms like Amazon and eBay allow multiple sellers to offer products to a global audience, creating a vast online marketplace.