

Unit 01

Computer Systems

Multiple Choice Questions (MCQs)

1	2	3	4	5	6	7	8	9	10
C	A	A	A	C	C	C	C	B	B
11	12	13	14	15	16	17	18	19	20
C	A	D	A	D	B	C	C	C	C

Short Response Questions (SRQs)

Q1. What is the principle of duality in Boolean algebra, and why is it important in digital logic?

Principle of Duality in Boolean Algebra

The principle of duality in Boolean algebra states that every algebraic expression is valid if the operators and identity elements are swapped. Specifically, every Boolean expression remains valid if AND and OR operators are interchanged and 0 and 1 are swapped. This principle is important in digital logic because it provides a systematic way to derive new expressions and simplifies the design and analysis of logic circuits.

Q2. How memory circuits use logic gates? Give their significance in digital systems.

Memory Circuits Using Logic Gates

Memory circuits, such as flip-flops and latches, use logic gates to store and maintain binary data. These circuits can hold a state indefinitely until they are changed by an input signal. The significance of memory circuits in digital systems lies in their ability to store data, which is essential for performing calculations, maintaining the current state of a system, and enabling complex functionalities like counters and registers.

Q3. Provide two examples of data encoding and decoding applications that involve logic gates.

Examples of Data Encoding and Decoding Applications

- Binary to Gray Code Converter

This involves using XOR gates to convert a binary number to its Gray code equivalent.

- Parity Bit Generator and Checker

Using XOR gates, a parity bit is added to a data set to ensure that the number of 1s is even (even parity) or odd (odd parity), aiding in error detection.

Q4. Give three uses of logic gates.

Uses of Logic Gates

- Arithmetic Operations: Adders and subtractors in digital circuits.
- Data Storage: Flip-flops and latches for memory elements.
- Control Systems: Logic gates in finite state machines for controlling sequences of operations.

Q5. What is the primary purpose of the Software Development Life Cycle (SDLC)?

Primary Purpose of the Software Development Life Cycle (SDLC)

- The primary purpose of the SDLC is to provide a structured and standardised process for developing high-quality software.
- It ensures that software is developed systematically, efficiently, and in a way that meets user requirements and business goals.

Q6. Name the different phases of SDLC.

Phases of SDLC

- Defining
- Planning
- Feasibility Study
- Requirements Analysis
- System Design
- Implementation (Coding)
- Testing
- Deployment
- Maintenance
- Documentation

Q7. Why feasibility study is important in the SDLC? Give three reasons.

Importance of Feasibility Study in SDLC

- Assessing Viability: Determines if the project is technically, economically, and operationally feasible.
- Risk Identification: Identifies potential risks and challenges early in the development process.
- Resource Allocation: Helps in the proper allocation of resources, including time, budget, and personnel.

Q8. How does the design phase contribute to the development of a software system?

Contribution of the Design Phase in SDLC

- The design phase translates requirements into detailed specifications and blueprints for constructing the software.
- It defines the system architecture, components, interfaces, and data models, which guides developers in the implementation phase.
- It ensures coherence and alignment with user needs.

Q9. What is the significance of testing/verification in SDLC?

Significance of Testing/Verification in SDLC

- Testing and verification ensure that the software meets specified requirements, is free of defects, and performs reliably under various conditions.
- This phase is crucial for identifying and fixing bugs, validating functionality, and ensuring the overall quality and user satisfaction of the final product.

Q10. Give three advantages and 2 disadvantages of Bus Topology in networking?

Advantages:

- Cost-Effective: Requires less cable length than other topologies, reducing costs.
- Simple Installation: Easy to set up and extend.

Disadvantages:

- Limited Scalability: Performance degrades as more devices are added.
- Single Point of Failure: If the main cable fails, the entire network goes down.

Q11. How does Mesh Topology provide redundancy in network communication?**Mesh Topology and Redundancy**

- In mesh topology, every device is connected to every other device.
- This provides redundancy because there are multiple paths for data to travel.
- If one path fails, data can be rerouted through another path, ensuring network reliability and robustness.

Q12. Compare and contrast Horizontal Scalability and Vertical Scalability in cloud computing.**Horizontal vs. Vertical Scalability in Cloud Computing**

- **Horizontal Scalability:** Involves adding more physical machines or nodes to the system (scaling out). It's useful for distributing load across multiple servers.
- **Vertical Scalability:** Involves adding more resources (CPU, RAM) to an existing machine (scaling up). It's useful for increasing the capacity of a single server.

Q13. Define cybersecurity. Also give its significance in today's interconnected world.**Cybersecurity**

- Cybersecurity involves protecting systems, networks, and data from digital attacks.
- Its significance in today's interconnected world lies in safeguarding sensitive information, ensuring privacy, and maintaining the integrity and availability of critical systems against cyber threats.

Q14. Name three common types of cybersecurity threats.**Common Types of Cybersecurity Threats**

- Phishing Attacks
- Malware
- Ransomware

Q15. What is the role of encryption in cybersecurity, and how does it protect sensitive data?**Role of Encryption in Cybersecurity**

- Encryption converts data into a coded format that can only be read by someone with the decryption key.
- It protects sensitive data by ensuring that even if data is intercepted or accessed by unauthorized parties, it remains unintelligible and secure.

Q16. Differentiate between symmetric and asymmetric encryption methods.**Symmetric and Asymmetric Encryption**

- **Symmetric Encryption:** Uses the same key for both encryption and decryption. It is faster but requires secure key distribution.
- **Asymmetric Encryption:** Uses a pair of keys (public and private) for encryption and decryption. It is more secure for key distribution but slower than symmetric encryption.

Q17. Why is it essential for individuals and organisations to keep their software up to date in terms of cybersecurity?**Importance of Keeping Software Up to Date for Cybersecurity**

- Patch Vulnerabilities: Updates fix security vulnerabilities that could be exploited by attackers.
- Improve Functionality: Updates often include improvements that enhance the security and performance of the software.

- Compliance: Keeping software updated ensures compliance with security standards and regulations.

Q18. What is 2FA (Two-Factor Authentication)? Give its importance in securing user accounts.

Two-Factor Authentication (2FA):

- 2FA is a security process in which users provide two different authentication factors to verify their identity.
- It is important because it adds an extra layer of security, making it more difficult for unauthorised users to access accounts.
- For Example: User Name and Password plus OTP

Q19. What is the primary purpose of a firewall in network security, and how does it work?

Primary Purpose of a Firewall in Network Security:

- A firewall monitors and controls incoming and outgoing network traffic based on predetermined security rules.
- It acts as a barrier between
 - Trusted internal network
 - Untrusted external networks
- It blocks malicious traffic while allowing legitimate communication.

Q20. What are the characteristics of a strong password? Give two examples.

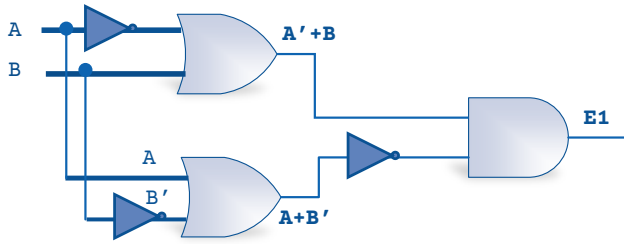
Characteristics of a Strong Password:

- Length: At least 12 characters long.
- Complexity: Includes a mix of uppercase and lowercase letters, numbers, and special characters.
- Examples:
 - `G5t\$2kM8!xQz`
 - `P@ssw0rd#2024`

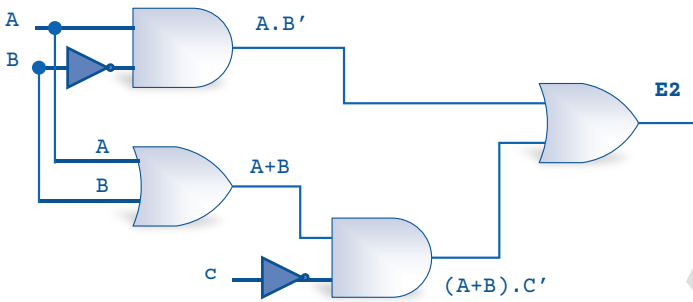
Extended Response Questions (ERQs)

Q1. Design logic circuits for the following Boolean functions.

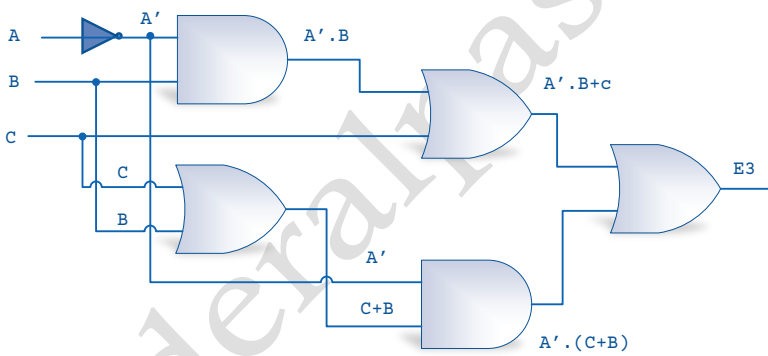
i. $E1 = (\bar{A} + B) \cdot (\overline{A + B})$



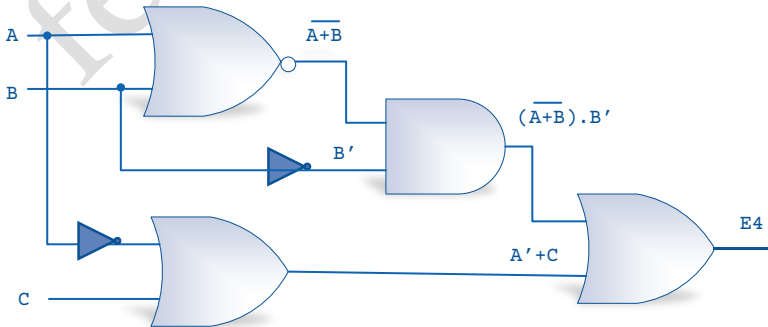
ii. $E2 = (A \cdot \bar{B}) + (A + B) \cdot (\bar{C})$



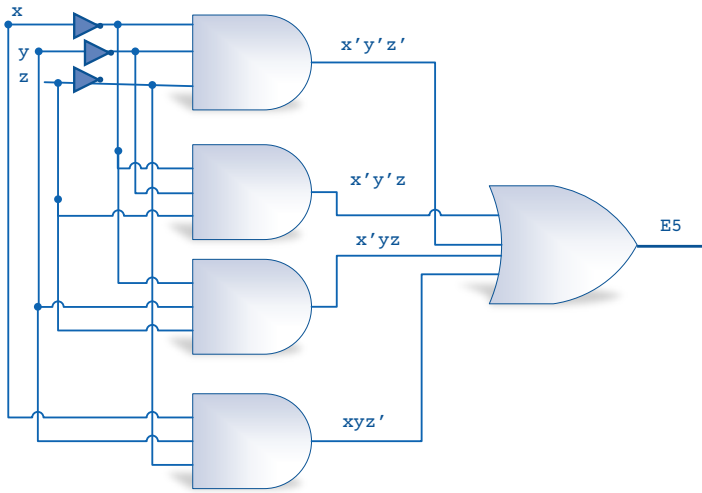
iii. $E3 = (\bar{A} \cdot B + C) + \bar{A} \cdot (C + B)$



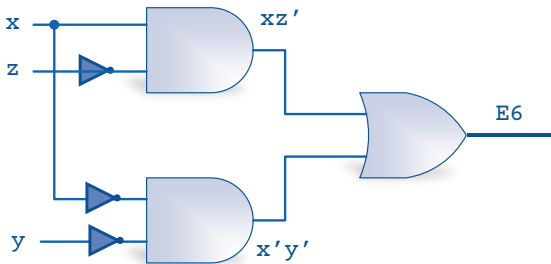
iv. $E4 = (\overline{A + B}) \cdot \bar{B} + (\bar{A} + C)$



v. $E5 = \bar{x} \bar{y} \bar{z} + \bar{x} \bar{y} z + \bar{x} y z + x y \bar{z}$



vi. $E6 = xz + \bar{x}y$



Q2. Draw truth tables for the Boolean functions in Q1.

i. $E1 = (\bar{A} + B) \cdot (\bar{A} + \bar{B})$

A	B	\bar{A}	\bar{B}	$\bar{A} + B$	$A + \bar{B}$	$\bar{A} + \bar{B}$	E1
0	0	1	1	1	1	0	0
0	1	1	0	1	0	1	1
1	0	0	1	0	1	0	0
1	1	0	0	1	1	0	0

ii. $E2 = (A \cdot \bar{B}) + (A+B) \cdot (\bar{C})$

A	B	C	\bar{B}	\bar{C}	$A \cdot \bar{B}$	A+B	$(A+B) \cdot (\bar{C})$	E2
0	0	0	1	1	0	0	0	0
0	0	1	1	0	0	0	0	0
0	1	0	0	1	0	1	1	1
0	1	1	0	0	0	1	0	0
1	0	0	1	1	1	1	1	1
1	0	1	1	0	1	1	0	1
1	1	0	0	1	0	1	1	1
1	1	1	0	0	0	1	0	0

iii. $E3 = (\bar{A} \cdot B + C) + \bar{A} \cdot (C+B)$

A	B	C	\bar{A}	$\bar{A} \cdot B$	$\bar{A} \cdot B + C$	C+B	$\bar{A} \cdot (C+B)$	E3
0	0	0	1	0	0	0	0	0
0	0	1	1	0	1	1	1	1
0	1	0	1	1	1	1	1	1

A	B	C	\bar{A}	$\bar{A} \cdot B$	$\bar{A} \cdot B + C$	C+B	$\bar{A} \cdot (C+B)$	E3
0	1	1	1	1	1	1	1	1
1	0	0	0	0	0	0	0	0
1	0	1	0	0	1	1	0	1
1	1	0	0	0	0	1	0	0
1	1	1	0	0	1	1	0	1

iv. $E4 = (\bar{A} + \bar{B}) \cdot \bar{B} + (\bar{A} + C)$

A	B	C	A+B	$\bar{A} + \bar{B}$	\bar{B}	$(\bar{A} + \bar{B}) \cdot \bar{B}$	\bar{A}	$\bar{A} + C$	E4
0	0	0	0	1	1	1	1	1	1
0	0	1	0	1	1	1	1	1	1
0	1	0	1	0	0	0	1	1	1
0	1	1	1	0	0	0	1	1	1
1	0	0	1	0	1	0	0	0	0
1	0	1	1	0	1	0	0	1	1
1	1	0	1	0	0	0	0	0	0
1	1	1	1	0	0	0	0	1	1

v. $E5 = \bar{x} \bar{y} \bar{z} + \bar{x} \bar{y} z + \bar{x} y z + x y \bar{z}$

x	y	z	\bar{x}	\bar{y}	\bar{z}	$\bar{x} \bar{y} \bar{z}$	$\bar{x} \bar{y} z$	$\bar{x} y z$	$x y \bar{z}$	E5
0	0	0	1	1	1	1	0	0	0	1
0	0	1	1	1	0	0	1	0	0	1
0	1	0	1	0	1	0	0	0	0	0
0	1	1	1	0	0	0	0	1	0	1
1	0	0	0	1	1	0	0	0	0	0
1	0	1	0	1	0	0	0	0	0	0
1	1	0	0	0	1	0	0	0	1	1
1	1	1	0	0	0	0	0	0	0	0

vi. $E6 = x \bar{z} + \bar{x} \bar{y}$

x	y	z	\bar{x}	\bar{y}	\bar{z}	$x \bar{z}$	$\bar{x} \bar{y}$	E6
0	0	0	1	1	1	0	1	1
0	0	1	1	1	0	0	1	1
0	1	0	1	0	1	0	0	0
0	1	1	1	0	0	0	0	0
1	0	0	0	1	1	1	0	1
1	0	1	0	1	0	0	0	0
1	1	0	0	0	1	1	0	1
1	1	1	0	0	0	0	0	0

Q4. Compare and contrast the Waterfall model and Agile model in software development. Which one do you think is more suitable for modern software development and why?

Waterfall Model

- **Step-by-Step:** Think of the waterfall model like following a recipe step by step. You finish one step before moving on to the next.
- **Predictable:** You know exactly what to expect at each stage, making planning easier.
- **Rigid:** Changes are hard to make once you have moved on to the next stage. It is like building a house - changing the foundation after you've started building is difficult.

Agile Model

- **Flexible:** Agile is more like making a dish where you can taste and adjust as you go along.
- **Iterative:** Instead of doing everything at once, you work in short sprints, making improvements along the way.
- **Focus on Customer:** It's all about giving the customer something they can use and get feedback quickly.

Comparison

- **Waterfall** is good for projects where everything is clear from the start, while **Agile** is better when things might change or if you need to get something out fast.
- **Waterfall** is like following a recipe exactly, while **Agile** is more like cooking with room to adjust flavors as you go.
- **Waterfall** can take longer and might not get feedback until the end, while **Agile** delivers small pieces regularly, so you can adjust quickly.

For Modern Software Development

- **Agile** tends to be more popular nowadays because things change fast in the tech world. It lets teams adapt quickly and get feedback from users early on, which is crucial in today's fast-paced environment.
- However, for some projects with clear requirements, **Waterfall** can still be a good fit. It all depends on the project and what works best for the team and the customer.

Q5. Discuss the role of Requirements Engineering in SDLC. What are the challenges and benefits of gathering and managing requirements effectively?

Role of Requirements Engineering in SDLC

Requirements Engineering ensures that everyone understands what the software needs to do and how it should behave. It involves gathering, analyzing, documenting, and managing these requirements throughout the project.

Challenges

- **Ambiguity:** Requirements are often unclear or contradictory.
- **Change:** Needs can evolve, requiring constant updates.
- **Communication:** Misunderstandings between stakeholders and developers.
- **Scope Creep:** Requirements can expand beyond the initial plan.
- **Conflicting Needs:** Different stakeholders may have conflicting priorities.

Benefits

- **Customer Satisfaction:** Meeting stakeholder needs leads to happier customers.
- **Less Rework:** Clear requirements reduce errors and rework.
- **Better Planning:** Helps with project planning, estimation, and resource allocation.
- **Risk Reduction:** Identifying issues early lowers the risk of project failure.
- **Enhanced Collaboration:** Facilitates better communication and decision-making among stakeholders.

Q6. Outline the various methods of system deployment/implementation mentioned in the text (Direct, Parallel, Phased, Pilot). Provide real-world scenarios where each deployment method would be most suitable.

Deployment/Implementation methods

The deployment or implementation of a system can be executed through the following methods.

Direct

In this method, the old system is entirely replaced by the new system all at once. The old system becomes obsolete.

Scenario: *Small business upgrading accounting software.*

Parallel

The parallel method involves running both the old and a new system concurrently for a certain time period. There is no risk of data loss.

Scenario: *A retail store tests a new inventory management system alongside the existing one for a month.*

Phased

The phased method facilitates a gradual transition from the old system to the new one. The new system is implemented in stages, gradually replacing the old system.

Scenario: *A company introduces a new email platform, starting with the IT department before rolling it out to other departments over several weeks.*

Pilot

In pilot method, the new system is initially developed for a small group of users. They use the new system and give feedback. If the user response is satisfactory then it is implemented for all users.

Scenario: *A school tests a new grading system with a small group of teachers before implementing it across all grade levels.*

Q7. Explain Bus, Star and Ring network topologies. Give their advantages and disadvantages.

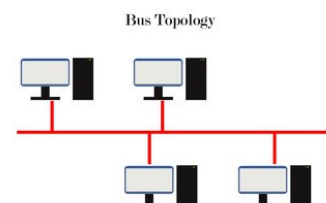
Network Topology

Network topology refers to the physical or logical layout of devices and connections in a computer network. Following are some kinds of network topologies.

- Bus topology
- Star topology
- Ring topology

Bus Topology:

In a bus topology, all devices are connected to a single backbone cable called *bus*. Each device communicates directly with the bus, and data is transmitted to all devices on the network. *Terminators* are used at both ends of the bus to prevent signal reflection.



Advantages:

- Simple and inexpensive to set up.
- Well-suited for small networks with a limited number of devices.

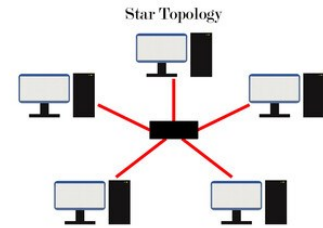
- Requires less cabling compared to other topologies.

Disadvantages:

- Limited scalability because adding more devices can degrade performance.
- If the main cable fails, the entire network can go down.
- Chances of signal interference and collisions, especially as the network grows.

2. Star Topology

In a star topology, each device on the network is connected to a central hub or switch. All communication between devices must pass through the central hub.



Advantages

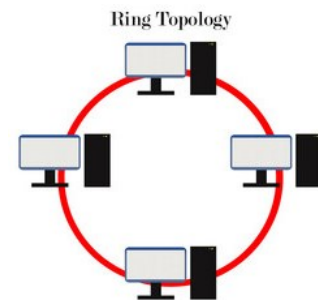
- Centralized management makes it easy to add, remove, or troubleshoot devices.
- Failure of one device does not affect the rest of the network.
- Better performance and less chance of collisions as compared to bus topology.

Disadvantages

- If central hub fails, the entire network goes down.
- Requires more cabling than bus topology, especially as the network grows.
- Expensive to set up and maintain, as it requires a central device called hub or switch.

3. Ring Topology

In a ring topology, each device is connected to two other devices, forming a closed loop. Data circulates around the ring in one direction, passing through each device until it reaches its destination.



Advantages:

- Each device has the same opportunity to transmit data.
- No collisions occur, as data travels in one direction only.
- Simple and easy to install as compared to other topologies.

Disadvantages:

- Failure of one device or cable segment can disrupt the entire network.
- Adding or removing devices can be complex and may require the network to be temporarily taken offline.
- Limited scalability; performance can degrade as the number of devices increases.

Q8. In the context of cloud computing, elaborate the concepts of scalability and reliability. How do these concepts contribute to the effectiveness of cloud services? Provide a real-world example.

Scalability in Cloud Computing

Scalability in cloud computing refers to the ability of a cloud system or service to handle increasing workloads by expanding resources (*scaling out*) or upgrading existing ones (*scaling up*). There are two main types of scalabilities in cloud computing.

1. Horizontal Scalability (Scaling out)

Horizontal scalability means increasing the number of servers that run the applications and distributing the workload among them. This can increase the scalability and availability of applications to users.

2. Vertical Scalability (Scaling Up)

Vertical scalability means increasing the capacity of a single server by adding more resources such as CPU, RAM, disk space or network bandwidth. This can improve the performance and reliability of the application.

Example

Netflix leverages cloud scalability during peak hours when millions of user stream content simultaneously. By dynamically allocating resources, Netflix ensures a smooth streaming experience without interruptions or buffering.

Reliability in Cloud Computing

Reliability in cloud computing refers to the ability of a cloud service or infrastructure to consistently deliver its intended functionality and maintain uptime, often called *high availability*. Reliability ensures that applications and services hosted in the cloud are accessible and perform as expected.

Example

Amazon Web Services (AWS) demonstrates reliability by operating multiple data centers across various locations. If one data center goes down due to a disaster or technical issue, AWS automatically redirects services to other functioning data centers, ensuring uninterrupted service for customers.

Q9. Explain Symmetric and Asymmetric encryption methods in the context of cybersecurity.

Symmetric Encryption

Symmetric encryption is a fundamental data protection technique. It relies on a single security key for both encrypting plain text and decrypting cipher text. It is one of the most widely used encryption technique.

Advantages

- It is generally faster and more efficient than asymmetric encryption.
- It provides high level of security when used with strong and randomly generated keys.
- It is simpler to implement and faster to execute.

Disadvantages

- The major challenge is securely distributing and managing secret keys.
- It is not suitable for secure communication between parties who have never met before or don't share a secret key.

Asymmetric Encryption

Asymmetric encryption uses two separate keys i.e. *public key* and *private key*. Mostly public key is used to encrypt the data while private key is required to decrypt data. The private key is only given to the users with authorized access. It is more effective but more expensive encryption technique.

Advantages

- This approach simplifies the complexities associated with key management. Each user has unique pair of private and public keys.

- The sender of a message cannot deny sending it because only their private key can decrypt the message.
- It is ideal approach for secure communication between parties who never met before or don't share a secret key.

Disadvantages

- Asymmetric encryption algorithms are more complex, slower and more time consuming when process large volume of data.
- Longer key lengths are required for achieving high level of security which increases the size of data and messages.

Q10. Imagine you are responsible for the cybersecurity of a large organization. Describe a comprehensive cybersecurity strategy that includes multiple layers of defense against various threats.

Cybersecurity Strategy

Following is a simplified cybersecurity strategy that can be used in large organizations to avoid cyber threats.

1. Know Your Risks

Understand potential threats like viruses, hackers, and data breaches.

2. Protect Your Network

Use firewalls and antivirus software to guard against attacks from the internet.

3. Secure Your Devices

Install antivirus software on computers and mobile devices to keep them safe from viruses and malware.

4. Use Strong Passwords

Create unique and complex passwords to protect accounts and sensitive information.

5. Two-Factor Authentication (2FA)

It requires from users to provide two forms of verification for access. For example, password and a code received on phone or email.

6. Be Careful Online

Avoid clicking on suspicious links or downloading files from unknown sources to prevent malware infections.

7. Keep Software Updated

Regularly update software and operating systems to stay protected against the latest threats.

8. Backup Your Data

Back up important files regularly to prevent data loss in case of malware attack or hardware failure.

9. Educate Yourself

Stay updated on cybersecurity news and best practices to protect yourself and others online.