# Computer Networks – FE Electrical Live Training Week # 11

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Focus of this homework assignment will be on the following topics of 'Computer Networks'.

- ❑ Network Topologies
- ❑ Network Models
- ❑ Protocols
- ❑ Network Security

**Helpful Tip – Utilize the following resources to get the most out of this this HW assignment.**

1. On-demand lectures, quizzes, deep dives and mini-exam.
2. MasterClass crash-course on this topic (try 1.25X or 1.5X speed for faster review).
3. Utilize exclusive community support for conceptual/technical questions

# Network Types

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**HW Problem # 1 –** Which type of network typically spans multiple cities or countries and relies on telecommunications infrastructure to connect devices over long distances?

**(A)** PAN
**(B)** LAN
**(C)** MAN
**(D)** WAN

# Network Topologies

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**HW Problem # 2 –** In a **bus topology**, what happens if the main communication cable (backbone) fails?

**(A)** Only the affected device loses connectivity, while others remain connected.
**(B)** The entire network fails, and no device can communicate.
**(C)** Network performance improves as fewer devices are connected.
**(D)** The network automatically reroutes traffic through alternate paths.

# Network Topologies

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**HW Problem # 3 –** In a **star topology**, what is the most significant result of a complete failure of the central hub or switch?

**(A)** The failure causes a total loss of network communication, as all data transmission depends on the central hub or switch.

**(B)** Only the devices directly connected to the failed hub or switch lose connectivity, while others continue to communicate.

**(C)** The network dynamically redistributes traffic through alternative paths to maintain connectivity.

**(D)** Network congestion is reduced, leading to improved performance for the remaining active devices.

# Network Topologies

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**HW Problem # 4 –** In a tree topology, which of the following best describes the most critical impact of a failure at a high-level node in the hierarchical structure?

**(A)** The failure results in a complete loss of communication for all dependent lower-level nodes, as they rely on the higher node for data transmission.
**(B)** Only the immediate connections of the failed node are disrupted, while the rest of the network continues functioning without issues.
**(C)** The network dynamically reconfigures itself, ensuring that all nodes remain operational through alternative paths.
**(D)** The failure leads to improved data transmission speeds for unaffected sections, as congestion is reduced.

# Network Topologies

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**HW Problem # 5 –** A city's public transportation system uses a network where buses follow a circular route, picking up and dropping off passengers at fixed intervals. Each bus follows the same path in one direction, and if a major stop or road is closed, the entire route is disrupted. This setup closely resembles which type of network topology?

**(A)** Star topology
**(B)** Tree topology
**(C)** Ring topology
**(D)** Mesh topology

# Network Types

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**HW Problem # 6 –** A computer network with a consistent data transmission speed between 100Mbps to 1000Mbps is most likely a _____.

A) LAN

B) MAN

C) WAN

D) Any of the above

# Network Topologies

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**HW Problem # 7 –** Suppose that it costs $10 to run a network cable between two nodes.

Calculate the total cost of running cables between 100 network devices if a full mesh is implemented.

# Network Models

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**HW Problem # 8 –** Match the entry in Column A with the relevant OSI model layer in Column B

| Column A | Column B |
|---|---|
| Layer # 2 | Physical Layer |
| JPEG | Network Layer |
| Simplex | Application Layer |
| IPv6 | Presentation Layer |
| UDP | Data Link Layer |
| Copper | Session Layer |
| | Transport Layer |

# Network Models

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**HW Problem # 9 –** Match the entry/ies in Column A with the relevant TCP/IP model layer in Column B

| Column A | Column B |
|---|---|
| HTTPS | Network Interface |
| UDP | Transport Layer |
| ICMP | Internet Layer |
| IPv6 | Application Layer |
| Fiber | Physical Layer |

# Network Models

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**HW Problem # 10 –** Which of the following functions is exclusively handled by the Physical Layer in the OSI Model?

**(A)** Managing logical addressing and routing packets across networks

**(B)** Converting data into electrical, optical, or radio signals for transmission

**(C)** Establishing, maintaining, and terminating end-to-end communication sessions

**(D)** Ensuring error detection and reliable data transfer between devices

# Network Models

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**HW Problem # 11 –** Which of the following is a primary responsibility of the Network Layer in the OSI Model?

**(A)** Managing end-to-end communication and ensuring reliable data transfer
**(B)** Handling encryption and decryption for secure data transmission
**(C)** Determining the best logical path for data to travel between source and destination
**(D)** Converting data into electrical, optical, or radio signals for physical transmission

# Network Models

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**HW Problem # 12 –** Which of the following is a primary function of the Application Layer in the OSI Model?

**(A)** Providing network services directly to end users and applications
**(B)** Managing logical addressing and forwarding of data packets across networks
**(C)** Ensuring reliable data transmission and error correction between devices
**(D)** Converting data into electrical, optical, or radio signals for transmission

# Network Models

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**HW Problem # 13 –** Which of the following is a primary function of the Presentation Layer in the OSI Model?

**(A)** Translating, encrypting, and compressing data for proper application-layer communication
**(B)** Establishing, maintaining, and terminating communication sessions between devices
**(C)** Managing logical addressing and determining the best path for data transmission
**(D)** Providing direct network services to end users and applications

# Network Models

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**HW Problem # 14 –** During data transmission over a network, a device is responsible for detecting and correcting errors at the frame level while ensuring proper MAC addressing. Which OSI layer performs this function?

**(A)** Network Layer
**(B)** Transport Layer
**(C)** Physical Layer
**(D)** Data Link Layer

# Network Models

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**HW Problem # 15 –** In a networked application, two devices need to establish, manage, and terminate an ongoing communication session. Which OSI layer is primarily responsible for handling this function?

**(A)** Presentation Layer
**(B)** Transport Layer
**(C)** Data Link Layer
**(D)** Session Layer

# Network Models

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**HW Problem # 16 –** A reliable file transfer application requires mechanisms for error detection, retransmission of lost packets, and flow control to ensure complete data delivery. Which OSI layer is primarily responsible for providing these functions?

**(A)** Network Layer
**(B)** Session Layer
**(C)** Transport Layer
**(D)** Data Link Layer

# Network Models

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**HW Problem # 17 –** In the context of network data encapsulation, which of the following best describes the correct order of data encapsulation as it moves from the Application Layer to the Physical Layer in the OSI Model?

**(A)** Bits → Frames → Packets → Segments → Data
**(B)** Data → Packets → Frames → Segments → Bits
**(C)** Data → Segments → Packets → Frames → Bits
**(D)** Packets → Frames → Segments → Data → Bits

# Network Models

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**HW Problem # 18 –** Which of the following network devices operates at the Network Layer (Layer 3) of the OSI Model and is responsible for forwarding data packets based on IP addresses?

**(A)** Router
**(B)** Hub
**(C)** Switch
**(D)** Bridge

# Network Models

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**HW Problem # 19 –** Which of the following networking devices operates at the Data Link Layer (Layer 2) of the OSI Model and is responsible for filtering and forwarding frames based on MAC addresses?

**(A)** Router
**(B)** Hub
**(C)** Switch
**(D)** Gateway

# IPv4 / IPv6

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**HW Problem # 20 –** An IPv4 datagram of 3600 bytes (including a 20-byte header) arrives at a router, which needs to forward it over a link with a Maximum Transmission Unit (MTU) of 620 bytes. How many fragments will the router generate?

**(A)** 5
**(B)** 6
**(C)** 7
**(D)** 8

# IPv4 / IPv6

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**HW Problem # 21 –** A packet is sent with a Time to Live (TTL) value of 128. It crosses 15 routers before reaching its destination. What will be the TTL value when it arrives at the destination?

**(A)** 112
**(B)** 113
**(C)** 115
**(D)** 118

# IPv4 / IPv6

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**HW Problem # 22 –** An IPv4 packet has a Total Length of 800 bytes. If the header length is 20 bytes, what is the size of the payload in bytes?

**(A)** 720
**(B)** 740
**(C)** 760
**(D)** 780

# IPv4 / IPv6

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**HW Problem # 23 –** Which of the following IPv4 header fields were removed in IPv6 to optimize packet processing and improve network efficiency?

**(A)** Identification, Flags, Fragment Offset, and Header Checksum

**(B)** Time to Live (TTL), Total Length, and Protocol

**(C)** Source and Destination IP Address, Options, and Padding

**(D)** Next Header, Payload Length, and Traffic Class

# IPv4 / IPv6

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**HW Problem # 24 –** The 4-bit IHL field of an IPv4 header has a value of 0111.

Determine the header length of this IPv4 datagram.

# IPv4 / IPv6

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**HW Problem # 25 –** Compress the following IPv6 into its most abbreviated form.

3022:0000:250C:0000:0000:0000:1245:AC1D

# IPv4 / IPv6

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**HW Problem # 26 –** Expand the following IPv6 into its most expanded form.

A:1860:0:10AB::D

# ICMP

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**HW Problem # 27 –** A network administrator is troubleshooting connectivity between two hosts using the ping command. The administrator observes that the destination host is unreachable, and an ICMP Type 3, Code 1 message is returned. What does this message indicate?

**(A)** The destination network is unreachable.

**(B)** The destination host is unreachable.

**(C)** The packet was dropped due to exceeding the Time-to-Live (TTL) value.

**(D)** The requested service on the destination is unavailable (port unreachable).

# UDP / TCP

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**HW Problem # 28 –** A video streaming application uses the User Datagram Protocol (UDP) instead of the Transmission Control Protocol (TCP) for data transmission. Which of the following best explains the primary reason for using UDP in this scenario?

**(A)** UDP provides guaranteed delivery and retransmission of lost packets.

**(B)** UDP reduces latency by avoiding connection setup and retransmission delays.

**(C)** UDP uses flow control to ensure data is transmitted at an optimal rate.

**(D)** UDP ensures packets arrive in order by establishing a connection before transmission.

# UDP / TCP

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**HW Problem # 29 –** An e-commerce payment system requires a reliable, connection-oriented protocol to ensure that no transaction data is lost or duplicated. Which transport layer protocol is best suited for this application?

**(A)** User Datagram Protocol (UDP), because it minimizes delay by avoiding connection overhead.

**(B)** Internet Control Message Protocol (ICMP), because it prioritizes network diagnostics over data transmission.

**(C)** Transmission Control Protocol (TCP), because it ensures reliable delivery, error checking, and retransmission.

**(D)** Hypertext Transfer Protocol (HTTP), because it manages secure financial transactions over the internet.

# UDP / TCP

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**HW Problem # 30 –** Match the entry/ies in Column A with correct protocol in Column B.

| Column A | Column B |
|---|---|
| Mandatory checksum calculation | UDP |
| Connectionless | TCP |
| Email application | |
| Video confrencing | |
| 8 byte fixed header length | |

# UDP / TCP

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**HW Problem # 31 –** The 4-bit Data Offset field of a TCP segment has a value of 0101 and window size field has a value of 0000000000000101.

Determine the header length of this TCP segment.

# Communication Methodolies

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**HW Problem # 32 –** Match the entry in Column A with correct transmission mode in Column B.

| Column A | Column B |
|---|---|
| Telephone | Simplex |
| Keyboard | Half Duplex |
| Walkie-Talkie | Full Duplex |
| One-way communication | |
| Two-way simultaneous communication | |

# Network Security

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**HW Problem # 33 –** Which of the following best describes the primary difference between a firewall and an Intrusion Detection System (IDS) in network security?

**(A)** A firewall detects malicious activity and alerts administrators, while an IDS actively blocks unauthorized traffic.

**(B)** A firewall filters incoming and outgoing traffic based on predefined rules, while an IDS monitors network activity for suspicious behavior.

**(C)** A firewall operates only at the application layer, while an IDS functions at the physical layer.

**(D)** A firewall can only protect against internal threats, while an IDS is specifically designed for external attacks.

# Network Security

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**HW Problem # 34 –** Match the entry in Column A with correct authentication mode in Column B.

| Column A | Column B |
|---|---|
| 4 digit pin | Something you have |
| Access card | Something you are |
| Fingerprint | Something you know |

# Network Security

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**HW Problem # 35 –** Batman and Robin are using Diffie-Hellman Key Exchange Protocol.

They publicly share prime modulus p = 23 and base generator g = 9.

Moreover, Batman select his private key as 4 and Robin selects his private key as 3.

Determine the value of their common secret key.

# Network Security

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**HW Problem # 36 –** Batman is using RSA cryptosystem to send secret messages to Robin.

Batman is using the prime numbers p = 13 and q = 17 to generate his public and private key.

If Batman's public key is 35, determine his private key.

# Network Security

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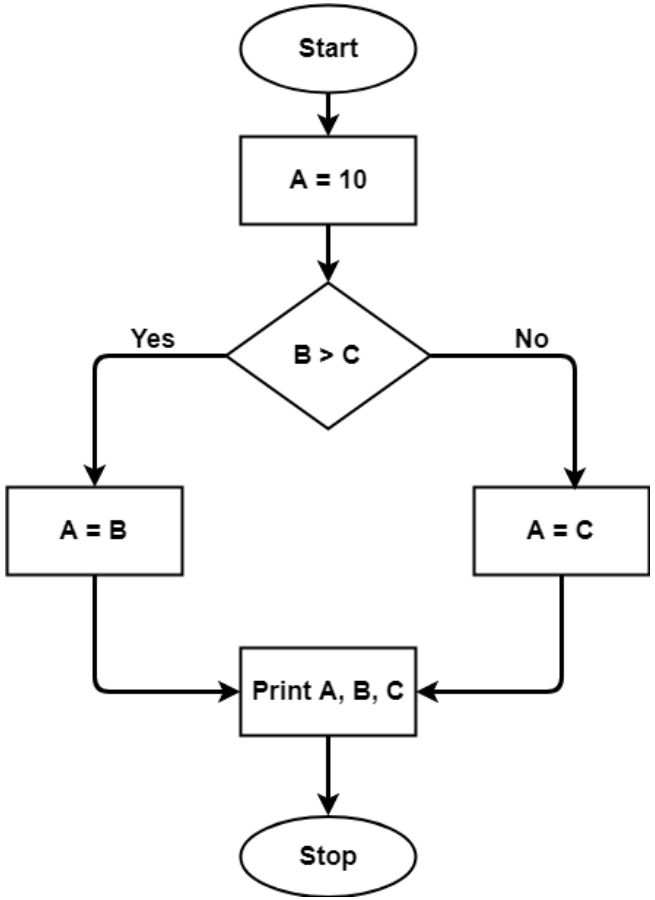
**HW Problem # 37 –** Determine McCabe's cyclomatic complexity for algorithm implemented by the flow chart.



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# Computer Networks – Answer Key

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1) D

2) B

3) A

4) A

5) C

6) A

7) $\$49500$

8) See Sol.

9) See Sol.

10) B

11) C

12) A

13) A

14) D

15) D

16) C

17) C

18) $A$

19) C

20) $B$

21) B

22) D

23) A

24) 28 bytes

25) See Sol.

26) See Sol.

27) B

28) B

29) C

30) See Sol.

31) 20 bytes

32) See Sol.

33) B

34) See Sol

35) 9

36) 11

37) c = 2