

QUESTION BANK: COMPUTER NETWORKS

Course: Paper-X (Computer Network) | **Comprehensive Evaluation Set**

UNIT I: Introduction to Data Communications & Network Models

1 Mark Questions (Short Answer Type)

- Q1. Define data communication.
- Q2. What are the three essential criteria a data communication network must meet?
- Q3. Name the five components of a data communications system.
- Q4. What is a protocol in computer networking?
- Q5. What is the difference between a standard and a protocol?
- Q6. List the seven layers of the OSI model in order.
- Q7. Which OSI layer is responsible for node-to-node frame delivery?
- Q8. What is the primary function of the Network Layer in the OSI model?
- Q9. Define an analog signal.
- Q10. Define a digital signal.
- Q11. What are the three types of transmission modes?
- Q12. Give an example of a simplex communication system.
- Q13. Define transmission impairment.
- Q14. What are the three main causes of impairment in transmission media?
- Q15. State the Nyquist theorem for noiseless channel capacity.
- Q16. State Shannon's formula for capacity of a noisy channel.
- Q17. What is the function of a network router?
- Q18. At which layer of the OSI model does a Hub operate?
- Q19. What is the key difference between a Hub and a Switch?
- Q20. What is the purpose of a repeater in a network?

2 Marks Questions (Brief Answer Type)

- Q1. Distinguish between half-duplex and full-duplex transmission modes.
- Q2. Explain the concept of attenuation in data transmission.
- Q3. What is distortion and how does it affect digital signals?
- Q4. Define bandwidth and distinguish it from data rate.
- Q5. Explain how a modem acts as both a modulator and a demodulator.
- Q6. Why is the OSI model called a theoretical framework, and how does it relate to TCP/IP?
- Q7. What is the function of the Transport layer regarding process-to-process delivery?
- Q8. Describe the function of a Bridge at the Data Link layer.
- Q9. What is thermal noise and how does it impact communication channels?
- Q10. Define bit rate and baud rate.
- Q11. Explain the role of standards organizations like ISO and IEEE in networking.

Q12. What is the difference between a Layer 2 switch and a Layer 3 switch?

Q13. Explain the physical layer's role in synchronization of bits.

Q14. What is signal-to-noise ratio (SNR) and why is a high SNR preferred?

Q15. Briefly define performance metrics: throughput and latency.

5 Marks Questions (Short Essay / Analytical Type)

Q1. Explain the five components of data communication with a neat structural diagram.

Q2. Compare and contrast the responsibilities of the Data Link Layer and Network Layer.

Q3. Discuss the three primary transmission impairments: Attenuation, Distortion, and Noise.

Q4. Derive and compare data rate limits using Nyquist Bit Rate and Shannon Capacity formulas with an example.

Q5. Explain the working principle and structural differences between a Hub, a Switch, and a Router.

Q6. Describe the functions of the Presentation layer and Application layer of the OSI model.

Q7. Analyze the operational concepts of Repeaters and Bridges in extending network boundaries.

Q8. Explain the concepts of periodic and non-periodic signals along with their key characteristics.

Q9. Discuss how propagation time and transmission time contribute to overall network latency.

Q10. What are protocols and standards? Explain why layering is indispensable in complex network models.

8 Marks Questions (Long Essay / Detail Comprehensive Type)

Q1. Provide a comprehensive, layer-by-layer breakdown of the OSI reference model, detailing the precise functions and encapsulation mechanisms at each layer.

Q2. Analyze the complete taxonomy of network connecting devices, detailing the operational layer, functional behavior, and advantages of Modems, Repeaters, Hubs, Switches, Bridges, and Routers.

Q3. Detail the characteristics of analog and digital signals. Compare them based on bandwidth, susceptibility to noise, transmission capacity, and practical implementation.

Q4. Formally evaluate the mathematical constraints on data rates. Solve scenarios using Nyquist and Shannon formulations, explaining the practical significance of channel capacity limits.

Q5. Discuss Transmission Modes (Simplex, Half-Duplex, Full-Duplex) and Performance Metrics (Bandwidth, Throughput, Latency, Jitter) in modern high-speed enterprise networks.

UNIT II: Signal Conversion, Transmission Media & Switching Techniques

1 Mark Questions (Short Answer Type)

- Q1. What is digital-to-digital conversion?
- Q2. Name one popular line coding scheme.
- Q3. Define modulation.
- Q4. What is the purpose of Analog-to-Digital conversion?
- Q5. Name the process commonly used for Analog-to-Digital conversion.
- Q6. What does ASK stand for in digital-to-analog modulation?
- Q7. Define guided transmission media.
- Q8. What are the three main types of guided media?
- Q9. Which guided medium uses light to transmit data streams?
- Q10. Define unguided transmission media.
- Q11. What is switching in data networks?
- Q12. Name the three primary categories of switching techniques.
- Q13. In which switching technique is a dedicated path established before data transfer?
- Q14. What is a datagram network?
- Q15. What is a virtual-circuit network?
- Q16. Define the term 'crosstalk' in twisted-pair cables.
- Q17. What is the core function of the structure of a switch?
- Q18. Which layer handles routing decisions in packet-switched networks?
- Q19. What type of propagation is used for line-of-sight wireless communication?
- Q20. What is a crossbar switch?

2 Marks Questions (Brief Answer Type)

- Q1. Explain the main difference between Unshielded Twisted Pair (UTP) and Shielded Twisted Pair (STP).
- Q2. Describe the basic mechanism of Pulse Code Modulation (PCM).
- Q3. Differentiate between Phase Shift Keying (PSK) and Frequency Shift Keying (FSK).
- Q4. What are the benefits of using Coaxial cable over Twisted-pair cable?
- Q5. Explain Total Internal Reflection as applied to optical fibers.
- Q6. What is the primary difference between Circuit Switching and Packet Switching?
- Q7. Define connectionless packet switching with a brief example.
- Q8. What is a permanent virtual circuit (PVC) compared to a switched virtual circuit (SVC)?
- Q9. Explain the function of the control unit within the structure of a switch.
- Q10. What are radio waves and what frequency range do they typically occupy?

- Q11.** Explain the concept of space-division switching.
- Q12.** Define quantization noise in the context of analog-to-digital conversion.
- Q13.** What is a multi-stage switch and why is it used?
- Q14.** Compare terrestrial microwave and satellite communication briefly.
- Q15.** What is Amplitude Modulation (AM) and how does it differ from Frequency Modulation (FM)?

5 Marks Questions (Short Essay / Analytical Type)

- Q1.** Explain line coding and its requirements. Describe Unipolar, Polar, and Bipolar schemes.
- Q2.** Describe Pulse Code Modulation (PCM) steps: Sampling, Quantization, and Encoding with supporting concepts.
- Q3.** Compare the structural properties, bandwidth capabilities, and applications of Twisted-pair, Coaxial, and Fiber-optic cables.
- Q4.** Explain the mechanism of Digital-to-Analog conversion techniques: ASK, FSK, and PSK with signal diagrams.
- Q5.** Detail Circuit Switching, highlighting the three distinct phases: setup, data transfer, and teardown.
- Q6.** Analyze Datagram Networks, focusing on routing tables, connectionless nature, and packet handling efficiency.
- Q7.** Explain Virtual-Circuit Networks, describing how identifiers (VCI) are used to forward packets through intermediate nodes.
- Q8.** Discuss the structural components of a modern switch, including input ports, output ports, the switching fabric, and the routing processor.
- Q9.** Explain unguided media propagation modes: Ground wave, Sky wave, and Space / Line-of-sight propagation.
- Q10.** Compare Space-Division Switching and Time-Division Switching within an electronic switching office system.

8 Marks Questions (Long Essay / Detail Comprehensive Type)

- Q1.** Provide an in-depth comparative analysis of Circuit Switching and Packet Switching models, evaluating them across parameters like latency, bandwidth efficiency, overhead, and reliability.
- Q2.** Comprehensive review of Signal Conversions: Detail the functional architecture and mathematical baselines of Line Coding (D-to-D), PCM (A-to-D), and Digital-to-Analog Modulation (ASK/FSK/PSK).
- Q3.** Examine Guided Media vs. Unguided Media. Detail physical structures, shielding mechanisms, attenuation properties, and operational use-cases for copper wire, fiber, and RF propagation.
- Q4.** Analyze the inner architecture of a Network Switch. Compare crossbar switches and multistage switches (e.g., Banyan networks), explaining blocking issues and resolution strategies.
- Q5.** Investigate Virtual-Circuit Networks vs. Datagram Networks. Detail step-by-step path setups, state table management, header structures, and recovery from switch failures.

UNIT III: Error Detection & Correction, Data Link Control & Access Control

1 Mark Questions (Short Answer Type)

- Q1. What is a checksum?
- Q2. What does CRC stand for in error detection?
- Q3. Define the primary goal of the Data Link Control layer.
- Q4. What is framing?
- Q5. Define flow control.
- Q6. What is error control?
- Q7. Name a protocol used for noiseless channels.
- Q8. What does ARQ stand for in network communication protocols?
- Q9. What is the sender window size in Stop-and-Wait ARQ?
- Q10. In Go-Back-N ARQ, if window size is 8, what is the maximum number of frames sent without acknowledgement?
- Q11. What is the key advantage of Selective Repeat ARQ over Go-Back-N ARQ?
- Q12. What does HDLC stand for?
- Q13. What is the Point-to-Point Protocol (PPP) primarily used for?
- Q14. Define multiple access control.
- Q15. What does CSMA/CD stand for?
- Q16. What is channelization?
- Q17. Name the three main channelization protocols.
- Q18. How are different users separated in CDMA?
- Q19. What is the purpose of bit stuffing in HDLC?
- Q20. What is a collision in a shared medium network?

2 Marks Questions (Brief Answer Type)

- Q1. How does a cyclic redundancy check (CRC) utilize binary division for error checking?
- Q2. Explain the difference between character stuffing and bit stuffing in framing.
- Q3. Contrast a noiseless channel model with a noisy channel model.
- Q4. Explain the feedback mechanism utilized in Stop-and-Wait ARQ.
- Q5. Why are sequence numbers required in flow control protocols?
- Q6. Explain the sliding window concept in data link protocols.
- Q7. What happens in Go-Back-N ARQ when a frame is lost or corrupted?
- Q8. Describe the three types of frames defined in HDLC.
- Q9. What is the role of LCP (Link Control Protocol) within the PPP framework?

- Q10.** Explain the concept of 'listen before talk' in CSMA systems.
- Q11.** What is the vulnerable time in pure ALOHA compared to slotted ALOHA?
- Q12.** Explain the concept of guard bands in Frequency Division Multiple Access (FDMA).
- Q13.** How does Time Division Multiple Access (TDMA) allocate channel bandwidth?
- Q14.** Define orthogonal codes in the context of CDMA architecture.
- Q15.** What is a 1-persistent CSMA strategy?

5 Marks Questions (Short Essay / Analytical Type)

- Q1.** Explain the working mechanism of the Internet Checksum calculation with a numeric example for transmission and verification.
- Q2.** Describe the complete mathematical procedure of Cyclic Redundancy Check (CRC) error detection with a sample generator polynomial.
- Q3.** Discuss the primary techniques used for framing: Character count, Flag bytes with byte stuffing, and Physical layer coding violations.
- Q4.** Compare the operating mechanics of Stop-and-Wait ARQ and the basic Sliding Window protocol.
- Q5.** Explain Go-Back-N ARQ protocol detailing sender/receiver window sizes and retransmission logic upon timeout.
- Q6.** Detail Selective Repeat ARQ protocol and explain why its buffer design is more complex than Go-Back-N.
- Q7.** Describe the frame format of HDLC and explain the functional differences between its Information, Supervisory, and Unnumbered frames.
- Q8.** Explain the CSMA/CD protocol mechanics and how a station detects and reacts to a packet collision.
- Q9.** Discuss the Point-to-Point Protocol (PPP) architectural phases, focusing on LCP and NCP execution.
- Q10.** Compare and contrast the internal mechanisms of FDMA and TDMA channelization techniques.

8 Marks Questions (Long Essay / Detail Comprehensive Type)

- Q1.** Elaborate on the Sliding Window Protocol taxonomy. Compare Stop-and-Wait ARQ, Go-Back-N ARQ, and Selective Repeat ARQ based on bandwidth utilization, buffer constraints, and error handling efficiency.
- Q2.** Provide an analytical study of Controlled Access vs. Random Access vs. Channelization. Evaluate CSMA/CD, ALOHA, TDMA, FDMA, and CDMA across multiple load patterns.
- Q3.** Detail the Data Link Layer's role in flow and error control. Present detailed chronological sequence diagrams showing frame losses and acknowledgments across noisy channels.
- Q4.** Explain the mathematical underpinnings of Code Division Multiple Access (CDMA). Walk through an algebraic proof demonstrating how chipping sequences extract individual signals.
- Q5.** Analyze HDLC and PPP protocols. Discuss frame fields, synchronous vs. asynchronous formatting, link establishment states, and authentication extensions.

UNIT IV: Network Layer, Transport Layer, Application Layer & Security

1 Mark Questions (Short Answer Type)

- Q1. What is logical addressing?
- Q2. How many bits are there in an IPv4 address?
- Q3. How many bits are there in an IPv6 address?
- Q4. Name the two protocols commonly used at the Transport Layer.
- Q5. What does UDP stand for?
- Q6. Is TCP connection-oriented or connectionless?
- Q7. What is the main function of DNS?
- Q8. Which protocol is used to transmit files securely or standardly between client and server?
- Q9. What does SMTP stand for?
- Q10. What is the function of POP3 in email delivery?
- Q11. Which application layer protocol is the foundation of the World Wide Web?
- Q12. What is the main standard used for WiFi networks?
- Q13. Define authentication in network security.
- Q14. What is a public key?
- Q15. What is a private key?
- Q16. What is a digital signature?
- Q17. What is the primary purpose of a digital certificate?
- Q18. Which transport protocol provides reliable byte-stream delivery?
- Q19. What is a port number?
- Q20. Define confidentiality in secure communications.

2 Marks Questions (Brief Answer Type)

- Q1. Explain the difference between classful addressing and classless addressing (CIDR) in IPv4.
- Q2. Why is the migration from IPv4 to IPv6 essential for the modern Internet infrastructure?
- Q3. Compare the delivery models of a connectionless service (UDP) and connection-oriented service (TCP).
- Q4. What is a three-way handshake in TCP connection establishment?
- Q5. Explain the hierarchy of DNS servers (Root, TLD, Authoritative).
- Q6. How do SMTP and POP3 work together in an email system architecture?
- Q7. Describe the basic operational concept of HTTP request and response messages.
- Q8. What is the function of an Access Point (AP) in a basic WiFi infrastructure?
- Q9. Distinguish between symmetric key cryptography and asymmetric key cryptography.
- Q10. How does a digital signature ensure non-repudiation?

- Q11.** What is a Certificate Authority (CA) and what is its role?
- Q12.** Explain the concept of process-to-process delivery using sockets.
- Q13.** What are well-known port numbers and who registers them?
- Q14.** Describe the basic framing concept of Frame Relay.
- Q15.** What is the cell size in Asynchronous Transfer Mode (ATM) networks and why is it fixed?

5 Marks Questions (Short Essay / Analytical Type)

- Q1.** Explain the structure of an IPv4 header, detailing the significance of fields like TTL, Protocol, and Source/Destination addresses.
- Q2.** Compare IPv4 and IPv6 features, focusing on address space, header simplicity, built-in security, and routing efficiency.
- Q3.** Describe the operation of TCP congestion control, detailing Slow Start, Congestion Avoidance, and Fast Retransmit states.
- Q4.** Explain how the Domain Name System (DNS) resolves a human-readable URL into an IP address using recursive and iterative queries.
- Q5.** Discuss the mechanisms of File Transfer Protocol (FTP), explaining why it utilizes separate connections for data and control.
- Q6.** Explain the fundamental layout of IEEE 802.11 (WiFi) architecture, including BSS, ESS, and infrastructure vs. ad-hoc modes.
- Q7.** Detail the principles of Public Key Cryptography (RSA style) and explain how it achieves confidential message transmission.
- Q8.** Explain how a Digital Signature is generated and verified using hashing algorithms and asymmetric key sets.
- Q9.** Discuss Process-to-Process Delivery, detailing multiplexing and demultiplexing processes at the Transport layer via ports.
- Q10.** Provide an overview of Frame Relay and ATM virtual circuit technologies, comparing their switching and relay methods.

8 Marks Questions (Long Essay / Detail Comprehensive Type)

- Q1.** Perform a deep architectural comparison between TCP and UDP. Analyze header structures, flow control, congestion handling, error checking, and suitability for real-time traffic.
- Q2.** Examine logical addressing. Detail the complete IPv4 addressing architecture (subnetting, VLSM, CIDR) and contrast it with IPv6 addressing formats and coexistence strategies.
- Q3.** Investigate Network Security foundations: Detail the mechanics of Public/Private Key Cryptography, generation of Digital Signatures, and verification of Digital Certificates via PKI.
- Q4.** Provide an exhaustive review of Application Layer Protocols: Analyze the request/response mechanics, port dependencies, connection tracking, and commands of DNS, HTTP, FTP, and SMTP.
- Q5.** Detail Virtual-Circuit Networks at the WAN scale: Frame Relay and ATM. Explain the motivation for fixed-size cells in ATM, quality-of-service provisions, and legacy implications.