**Critical questions related Computer Network (2024-25)**

**Topic: Introduction**

Q1. Assume six devices are arranged in a mesh topology. How many cables are needed? How many ports are needed for each device?

Q2. For each of the following four networks, discuss the consequences if a connection fails.

1. Five devices arranged in a mesh topology
2. Five devices arranged in a star topology (not counting the hub)
3. Five devices arranged in a bus topology
4. Five devices arranged in a ring topology

Q3. You have two computers connected by an Ethernet hub at home. Is this a LAN, a MAN, or a WAN? Explain your reason.

Q4. Draw a hybrid topology with a ring backbone and two bus networks.

Q5. You are tasked with designing a new network for a small office with 20 employees. The office requires reliable internet access, shared resources like printers, and minimal downtime. Which network topology would you choose and why?

Q6. Assume that source S and destination D are connected through two intermediate routers labeled R. Determine how many times each packet has to visit the network layer and the data link layer during a transmission from S to D.

https://media.geeksforgeeks.org/wp-content/uploads/Q14.png

Q7. Choose the best matching between **Group 1** and **Group 2**:

**Group-1**

P. Data link layer  
Q. Network layer  
R. Transport layer

**Group-2**

1. Ensures reliable transport of data over a physical point-to-point link  
2. Encodes/decodes data for physical transimission  
3. Allows end-to-end communication between two processes  
4. Routes data from one network node to the next

Q8. You send an email from your computer to a colleague's computer in another country. Which OSI layers are involved in this process, and what roles do they play?

Q9. How can the OSI model be utilized as a framework for troubleshooting network issues? Discuss a systematic approach to diagnosing problems using the layers of the OSI model.

Q10. Compare and contrast the OSI model with the TCP/IP model. What are the strengths and weaknesses of each model, and in what scenarios might one be preferred over the other?

**Topic: Physical layer**

Q1. How does noise affect the transmission of analog signals compared to digital signals, and what techniques can be applied to mitigate this interference in each type?

Q2. What are the key differences between a periodic and a non-periodic analog signal, and how do these differences impact data transmission efficiency in communication networks?

Q3. What are the main types of transmission impairments (such as attenuation, noise, and distortion), and how do they affect signal quality in both wired and wireless communication?

Q4. In what scenarios would a unipolar line coding scheme be preferred over a polar scheme, and how do these schemes affect bandwidth usage and error rates?

Q5. How do Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), and Frequency Shift Keying (FSK) compare in terms of noise resistance and data rate performance? Which would be the most suitable for high-noise environments, and why?

Q6. How does Time-Division Multiplexing (TDM) differ from Frequency-Division Multiplexing (FDM), and what are the advantages and limitations of each in terms of bandwidth utilization?

Q7. What are the pros and cons of using fiber optic cables versus traditional copper cables in terms of speed, cost, and resistance to interference for long-distance data transmission?

Q8. Compare circuit switching, packet switching, and message switching. How does each method handle latency, resource allocation, and data integrity in real-time applications like video conferencing?

Q9. How do routers, switches, and hubs differ in their handling of network traffic, and which would be the most efficient in a large-scale enterprise network?

Q10. How does the choice of modulation technique (e.g., ASK, PSK, FSK) affect the choice of physical transmission media, and what constraints or benefits do certain media impose on modulation techniques?

**Topic: MAC Sublayer**

Q1. What is the total delay (latency) for a frame of size 5 million bits that is being sent on a link with 10 routers each having a queuing time of 2 μs and a processing time of 1 μs. The length of the link is 2000 Km. The speed of light inside the link is 2 x 108 m/s. The link has a bandwidth of 5 Mbps. Which component of the total delay is dominant? Which one does dominant the transmission time?

Q2. We have a pure ALOHA network with 100 stations. If *Tfr* = 1μs. what is the number of frames/s each station can send to achieve the maximum efficiency.

Q3. One hundred stations on a pure ALOHA network share a l-Mbps channel. If frames are 1000 bits long, find the throughput if each station is sending 10 frames per second.

Q4. In a *CDMAlCD* network with a data rate of 10 Mbps, the minimum frame size is found to be 512 bits for the correct operation of the collision detection process. What should be the minimum frame size if we increase the data rate to 100 Mbps? To 1 Gbps? To 10 Gbps?

Q5. A network has a data transmission bandwidth of 20 × 106 bits per second. It uses CSMA/CD in the MAC layer. The maximum signal propagation time from one node to another node is 40 microseconds. The minimum size of a frame in the network is \_\_\_\_\_\_\_\_\_ bytes.

Q6. The minimum frame size required for a CSMA/CD based computer network running at 1 Gbps on a 200m cable with a link speed of 2 × 108m/s is\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Q7. Consider a network using the pure ALOHA medium access control protocol, where each frame is of length 1,000 bits. The channel transmission rate is 1 Mbps (=106 bits per second). The aggregate number of transmissions across all the nodes (including new frame transmissions and retransmitted frames due to collisions) is modelled as a Poisson process with a rate of 1,000 frames per second. Throughput is defined as the average number of frames successfully transmitted per second. The throughput of the network (rounded to the nearest integer) is?

Q8. Consider a CSMA/CD network that transmits data at a rate of 100 Mbps (108 bits per second) over a 1 km (kilometre) cable with no repeaters. If the minimum frame size required for this network is 1250 bytes, what is the signal speed (km/sec) in the cable?

Q9. A 2 km long broadcast LAN has 107 bps bandwidth and uses CSMA/CD. The signal travels along the wire at 2 × 108 m/s. What is the minimum packet size that can be used on this network?

Q10. There are n stations in a slotted LAN. Each station attempts to transmit with a probability p in each time slot. What is the probability that ONLY one station transmits in a given time slot?

**Topic: Logical Link Control Sublayer**

Q1. Consider two nodes A and B on the same Ethernet segment, and suppose the propagation delay between the two nodes is 300 bit times. Suppose at time both nodes A and B begin to transmit a frame. Assume both nodes transmit a 60 bit jamming signal after detecting a collision. For 10^7 bits per set Ethernet, find the time at which both nodes A and B sense an idle Channel?

Q2. A **1000-byte** frame is transmitted over an HDLC link with a transmission rate of **10 Mbps**. The protocol adds an overhead of **50 bytes** for framing and control information. What is the efficiency of the link, defined as the ratio of useful data to the total transmitted data?

Q3. Nodes A and B are connected by a 100 Mbps Ethernet segment with 6 micro second propagation delay between them. Suppose A and B send frames at t=0 and frames get collided. After first collision A draws k=0 and B draws k=1 (exponential backoff algorithm). If jamming signal is ignored and timeout time is one RTT then at what time A’s packet gets completely delivered to B? Assume packet size is of 1000 bits.

Q4. A system uses the Stop –N- Wait protocol. If each packet carries 1000 bits of data, how long does it take to send 1 million bits of data if the distance between the sender and receiver is 5000km and the propagation speed is 2\*10^8 meter. Ignore transmission, waiting and processing delays. We assume no data or control frame is damaged or lost.

Q5. In a Stop and Wait ARQ bandwidth 1 MBPS and 1 bit takes 20ms to make a round trip if system data frame are 1000 bit’s in length what is the efficiency utilization of the link? In same question if Go Back N ARQ with 15 frames are used then what would be the efficiency utilization of link.

Q6. Consider the Cyclic Redundancy Check (CRC) based error detecting scheme having the generator polynomial X3+X+1. Suppose the message m4m3m2m1m0 = 11000 is to be transmitted. Check bits c2c1c0 are appended at the end of the message by the transmitter using the above CRC scheme. The transmitted bit string is denoted by m4m3m2m1m0c2c1c0. What is the value of the check-bit sequence c2c1c0?

Q7. Consider GB-N ARQ is used for flow control, frame size is 4000 bits, data transfer rate of channel is 1 GBPS and one way propagation delay is 18ms. Then what should be the minimum value of sender window size and minimum number of bits required for sequence number field for maximum utilization is.

Q8. Consider a 128\*10^3 bits/second satellite communication link with on way propagation delay of 150 milliseconds. Selective retransmission (repeat) protocol is used on this link to send data with a frame size of 1 Kilobyte. Neglect the transmission time of acknowledgment. What is the minimum number of bits required for the sequence number field to achieve 100% utilization?

Q9. Consider a set of communicating devices (transmitter and receiver) that are using a simple single bit even parity check for error detection. The transmitter sends the following 8 bit sequence: 11001010. However, owing to channel noise the receiver instead gets the following bits: 10001011. Can the receiver detect the error? Explain why or why not?

Q10. Compute the fraction of the bandwidth that is wasted on overhead (headers and retransmissions) for a protocol on a heavily loaded 50 Kbps satellite channel with data frames consisting of 40 bits header and 3960 data bits. Assume that the signal propagation time from the earth to the satellite is 270 msec. ACK frames never occur. NAK frames are 40 bits. The error rate for data frames is 1% and the error rate for NAK frames is negligible.

**Topic: Network layer**

Q1. An organization is assigned the IP address block 192.168.1.0/24. They want to divide this block into 8 equal subnets. What will be the subnet mask for each subnet, and how many usable host addresses will each subnet have?

Q2. Consider an IP address 192.168.12.10 with a subnet mask of 255.255.255.240. What is the network address and the broadcast address for the subnet?

Q3. A router is configured with the IP address 10.10.5.1/20. What is the first and last valid host address for this subnet?

Q4. You are given the following IP addresses: 192.168.1.0/24, 192.168.2.0/24, 192.168.3.0/24, and 192.168.4.0/24. What is the summarized (supernet) address that can represent all these networks?

Q5. An IP address is given as 172.16.100.50. What class does this address belong to? Determine the default subnet mask for the address and the number of networks and hosts it can support.

Q6. You are given an IP address 192.168.10.0/24. The network needs to be divided into 4 subnets. What should be the subnet mask, and how many usable host addresses will each subnet have?

Q7. Given an IP address 172.16.50.10 with a subnet mask of 255.255.255.192, determine:

* The subnet address.
* The broadcast address.
* The range of valid host addresses within this subnet.

Q8. An organization is assigned the IP address block 10.0.0.0/16. The network administrator wants to create at least 500 subnets. What is the minimum subnet mask that should be used, and how many hosts can each subnet support?

Q9. In a local network, a host with IP address 192.168.1.10 needs to send data to another host with IP address 192.168.1.20. Explain the role of the Address Resolution Protocol (ARP) in this communication. How does the ARP process work to find the MAC address of the destination host?

Q10. An organization uses a private IP address block 10.0.0.0/8 for its internal network. The organization has a single public IP address 203.0.113.5 for internet access. Explain how Network Address Translation (NAT) works in this scenario to allow multiple internal hosts to access the internet. What are the roles of source IP address and port number in NAT?

**Topic: IPv4 and IPv6**

Q1. What are the core reasons behind the depletion of IPv4 addresses, and why was extending the address space with IPv6 the best solution?

Q2. How does IPv6 ensure that the growing demand for unique IP addresses, especially with the proliferation of IoT devices, is met effectively?

Q3. What are the primary structural differences between IPv4 and IPv6 headers, and how do these changes impact data transmission efficiency and speed?

Q4. Given that IPv6 does not inherently support NAT (Network Address Translation) like IPv4, how does it ensure security without relying on this feature?

Q5. What are the potential risks associated with IPv6 adoption, and how can network administrators address these risks to ensure secure and reliable transitions from IPv4?

Q6. How does IPv6 improve upon multicast and anycast addressing compared to IPv4, and what advantages do these improvements offer in modern networking scenarios?

Q7. What role does Stateless Address Autoconfiguration (SLAAC) in IPv6 play in reducing network complexity, and how does it compare to the DHCP-based IP address assignment in IPv4?

Q8. Why is the adoption rate of IPv6 still relatively slow despite its numerous advantages over IPv4, and what factors contribute to this hesitation?

Q9. How does the Neighbor Discovery Protocol (NDP) in IPv6 compare to ARP (Address Resolution Protocol) in IPv4, and what advantages does it bring in terms of network management and security?

Q10. In the context of modern cybersecurity threats, how does IPv6 address the vulnerabilities present in IPv4, and what new security challenges does it introduce?

**Topic: Transport layer and Session layer**

Q1. Explain the major design issues in networking and how they influence the performance and scalability of a network.

Q2. Describe the TCP connection management process, including the three-way handshake and teardown procedure. Why is it crucial for ensuring reliable data transmission?

Q3. What is the purpose of flow control in networking? Compare flow control methods in TCP and UDP.

Q4. Explain how TCP uses window management to ensure efficient data transmission. What is the role of the receiver's window size?

Q5. A TCP connection starts with a congestion window size of 1 MSS (Maximum Segment Size) and grows according to the slow-start algorithm. After 6 round-trip times (RTTs), if no loss occurs, what will be the size of the congestion window in MSS?

Q6. Compare TCP's connection-oriented management with UDP's connectionless model. What are the advantages and disadvantages of each?

Q7. After the slow start phase, TCP enters the congestion avoidance phase. How does this phase function, and what key metrics are involved in this transition?

Q8. What are the challenges in implementing remote procedure calls (RPC) over a network? Explain how RPCs handle the difference between local and remote procedure invocation.

Q9. How do flow control and congestion control differ in TCP? Why is it important to differentiate between the two?

Q10. What are the primary design issues addressed in the TCP/IP protocol suite, and how do they ensure efficient communication in heterogeneous networks?

**Topic: Presentation layer**

Q1. Prove that the compression ratio of Huffman coding is always less than or equal to that of a fixed-length code for the same set of symbols.

Q2. In RSA encryption, if p=11 and q=13, find the public and private keys, and show how a message M=7 is encrypted and decrypted.

Q3. Calculate the entropy of a source with the following symbol probabilities: p(A)=0.4, p(B)=0.3, p(C)=0.2, and p(D)=0.1.

Q4. In AES, the key size can be 128, 192, or 256 bits. Calculate the number of possible keys for each key size.

Q5. Consider a block cipher with a block size of 64 bits. What is the probability that no collision occurs when encrypting 100 blocks using the same key (ignoring the message content)?

Q6. Explain how data compression can improve network performance and give an example of where this is particularly beneficial.

Q7. Compare and contrast AES and RSA encryption in terms of security and performance.

Q8. For an LZW compression algorithm, show the dictionary entries after encoding the string "ABABABABA".

Q9. A 2D binary image has the following row of pixels:  
11110000111100001111

Using **Run-Length Encoding (RLE)**, calculate the compression ratio. Assume that the original image uses one bit per pixel and RLE uses a fixed 8-bit integer for storing each run length.

Q10. Given a source that generates symbols X1, X2, X3 , X4​ with probabilities P(X1)=0.4, P(X2​)=0.3, P(X3​)=0.2, and P(X4)=0.1, use the **Shannon-Fano encoding** algorithm to generate a binary code for each symbol.

1. Calculate the average length of the encoded message.
2. Compare the result to the entropy of the source.

**Topic: Application layer**

Q1. A user is trying to upload a file to a web server via a web application using HTTP, but the file upload fails consistently. What could be the possible reasons for this failure?

Q2. A company’s DNS server is down, and users are unable to access the company's website or send emails. How does this DNS outage affect HTTP and SMTP operations?

Q3. A company’s email server uses SMTP for outgoing emails. Some emails are being marked as spam by recipients' servers, and others are not delivered at all. What could be causing this, and how can it be resolved?

Q4.You are tasked with setting up a virtual terminal using TELNET for remote system management. After configuration, the connection works but is deemed insecure. What are the security risks of using TELNET, and how can you mitigate them?

Q5. A company is experiencing slow email delivery and sometimes failure of email messages to reach external domains. The issue seems intermittent. What troubleshooting steps should be taken to diagnose whether the issue is with DNS, SMTP, or the network?

Q6. A user reports that they can’t access a remote server using TELNET, but they can ping the server’s IP address. What could be causing this issue, and how would you resolve it?

Q7. A web application uses HTTP for file transfer, but users are experiencing slow download speeds, especially when downloading large files. What factors could contribute to this issue?

Q8. After changing the company’s email domain, some emails sent to external recipients are bouncing back with errors. What DNS-related settings should be checked and updated?

Q9. An organization’s IT team is migrating their email system, but during the transition, users complain that they are unable to receive emails from certain external domains. How could DNS configurations be impacting this issue?

Q10. A user is attempting to access a website, but the browser returns a “DNS server not responding” error. What could be causing this, and how would you troubleshoot it?