COMPUTER COMMUNICATION NETWORKS
(MCA 1202)

Time Allotted: 2½ hrs **Full Marks: 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which of the following devices operates at the Physical Layer of the OSI model?
(a) Router (b) Switch (c) Repeater (d) Gateway.

(ii) Which type of switching establishes a dedicated communication path between two nodes for the duration of their communication session?
(a) Circuit Switching (b) Message Switching
(c) Packet Switching (d) Virtual Circuit Switching.

(iii) What is the purpose of modulation in analog transmission?
(a) To encrypt data for secure transmission
(b) To increase the data rate of transmission
(c) To convert digital signals to analog signals
(d) To impress data onto a carrier signal for transmission.

(iv) Which process is used in framing to ensure proper synchronization of data?
(a) Character Stuffing (b) Bit Stuffing
(c) Error Detection (d) Error Correction.

(v) Which error correction technique can correct single-bit errors?
(a) Hamming Code (b) CRC
(c) Stop-and-Wait ARQ (d) Parity Check.

(vi) Which LAN technology is based on the IEEE 802.3 standard?
(a) Ethernet (b) FDDI (c) DQDB (d) Token Ring.

(vii) What is the purpose of bit stuffing in the framing process?
(a) To ensure proper synchronization of data
(b) To detect errors in transmitted data
(c) To divide the data into manageable frames
(d) To avoid long sequences of consecutive bits with the same value.

(viii) Which routing algorithm is used in Distance Vector Routing?
(a) Dijkstra's algorithm (b) Bellman-Ford algorithm
(c) Floyd-Warshall algorithm (d) Prim's algorithm.

(ix) ARP is used to
(a) Map IP addresses to physical MAC addresses
(b) Determine the best route for data packets
(c) Translate domain names to IP addresses
(d) Establish secure connections between hosts.

(x) Quality of Service (QoS) refers to
(a) Ensuring the network operates at maximum capacity
(b) Providing a consistent level of performance to different types of traffic
(c) Minimizing network latency
(d) Maximizing network security.

Fill in the blanks with the correct word

(xi) _____ routing algorithms build a map of the network and calculate routes based on that information.

(xii) _____ is a protocol used for testing connectivity and diagnosing network problems

(xiii) The Network Layer is responsible for _____ and _____ of data between hosts on different networks.

(xiv) The _____ algorithm is a method used for regulating traffic in a network by maintaining a constant transmission rate.

(xv) Sliding Window Protocols allow for _____ frames to be in transit at any given time.

Group - B

2. (a) Data link layer ensures delivery within the same physical network, but transport layer ensures delivery across networks – Explain. *[(CO1)(Understand/LOCQ)]*

(b) Consider a mesh network topology with n devices, where each device is connected to every other device. If the number of devices doubles, how does it affect the total number of connections in the network? Evaluate the scalability of this topology in terms of the number of connections required and the potential increase in network traffic overhead. *[(CO1)(Evaluate/HOCQ)]*

(c) Differentiate between MAC address and IP address. *[(CO1)(Understand/LOCQ)]*

4 + 5 + 3 = 12

3. (a) Find the maximum bit rates for an FSK signal if the bandwidth of the medium is 12,000 Hz and the difference between the two carriers must be at least 2000 Hz. Transmission is full duplex. *[(CO2)(Apply/IOCQ)]*

(b) Use Manchester & Differential Manchester line encoding technique to encode the following binary string: 1010110101 *[(CO2)(Apply/IOCQ)]*

(c) Television channels are 8MHz wide. How many bits per second can be sent if 8 level digital signals are used? Assume SNR of the channel as 30dB. *[(CO2)(Apply/IOCQ)]*

4 + (2 + 2) + 4 = 12

Group - C

4. (a) Discuss the types of errors that can occur in data transmission, focusing on single-bit errors. Explain how error detection and correction techniques help in mitigating these errors. *[(CO3)(Analyse/IOCQ)]*

(b) Write the steps to generate hamming code. Prepare Hamming code for the bit pattern 10101010. Suppose while transmitting error occurred in 7^{th} bit, write the bit pattern at receiver. Using hamming code, explain how you will detect and correct the error. *[(CO3)(Apply/IOCQ)]*

(2 + 3) + (3 + 2 + 2) = 12

5. (a) Compare and contrast random access techniques including ALOHA and Slotted ALOHA. Analyze their advantages and disadvantages in terms of efficiency and collision handling. *[(CO3)(Analyse/IOCQ)]*

(b) If transmission delay and propagation delay in a sliding window protocol are 1 msec. and 49.5 msec. respectively, then:

I. What should be the sender window size to get the maximum efficiency?

II. What is the minimum number of bits required in the sequence number field?

III. If only 6 bits are reserved for sequence numbers, then what will be the efficiency? *[(CO3)(Apply/IOCQ)]*

(4 + 2) + (2 + 2 + 2) = 12

Group - D

6. (a) Explain the Link State Routing algorithm in the Network Layer. Discuss its features, including how routers build and maintain a network topology database for efficient routing. *[(CO4)(Understand/LOCQ)]*

(b) Discuss the Reverse Address Resolution Protocol (RARP) in the Network Layer. Explain its functionality and how it enables devices to discover their IP addresses based on their MAC addresses. *[(CO4)(Remember/LOCQ)]*

(3 + 3) + (3 + 3) = 12

7. (a) Compare and contrast IPv4 and IPv6 addressing schemes. Discuss their differences in address representation, size, and allocation, as well as the implications for network scalability and management. *[(CO4)(Analyse/IOCQ)]*

(b) Consider a network with the IP address range 192.168.10.0/24. Perform subnetting to create three subnets with different subnet masks. Each subnet should accommodate a specific number of hosts according to the following requirements:

i. Subnet A should accommodate up to 30 hosts.

ii. Subnet B should accommodate up to 60 hosts.

iii. Subnet C should accommodate up to 12 hosts.

For each subnet, calculate:

1. The subnet mask.
2. The range of valid IP addresses in the subnet, including the network address and the broadcast address.
3. The number of usable IP addresses in the subnet.

Show all your calculations. *[(CO4)(Apply/IOCQ)]*

(3 + 3) + (2 + 2 + 2) = 12

Group - E

8. (a) Describe the structure and operation of the User Datagram Protocol (UDP) in the Transport Layer. Discuss its advantages, limitations, and applications in network communication. *[(CO5)(Understand/IOCQ)]*

   (b) Distinguish between open-loop congestion control and closed-loop congestion control. *[(CO5)(Understand/LOCQ)]*

(4 + 2) + 6 = 12

9. (a) Explain the Token Bucket algorithm and its role in improving Quality of Service. Discuss how it manages traffic by allowing or denying data packets based on token availability. *[(CO6)(Understand/LOCQ)]*

   (b) Compare and contrast DNS and HTTP protocols in terms of their functionalities, communication models, and use cases in network communication. *[(CO6)(Analyse/IOCQ)]*

(3 + 3) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	32.3	62.5	5.2

Course Outcome (CO):

After the completion of the course students will be able to

MCA1202.1 Recall basic data communication and networking concepts like communication modes, topology, protocols, standards, layered tasks, reference models, connecting devices, switching.
MCA1202.2 Identify signals, digital and analog transmission, multiplexing, transmission media.
MCA1202.3 Interpret different framing, error correction, error detection, flow control and channel access protocols.
MCA1202.4 Examine the working principle of different routing and addressing schemes, different network layer protocols.
MCA1202.5 Evaluate different process to process delivery, congestion control and quality of service protocols.
MCA1202.6 Design network applications using different application layer protocols.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*