COMPUTER NETWORKS
(CBS3102)

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) What is the maximum length of CAT-5 UTP cable in a Fast Ethernet network?
(a) 200 meters (b) 100 meters
(c) 1000 meters (d) 500 meters

(ii) Choose the correct option
(a) ARP is MAC-to-IP mapping, RARP is IP-to-MAC mapping
(b) ARP is MAC-to-IP mapping, RARP is MAC-to-MAC mapping
(c) ARP is IP-to-MAC mapping, RARP is MAC-to-IP mapping
(d) ARP is MAC-to-IP mapping, RARP is MAC-to-IP mapping

(iii) Which of the following is true?
(a) Distance vector and link state routing has equal message complexity
(b) Distance vector has lower message complexity than link state routing
(c) Link state routing has lower message complexity than distance vector
(d) None of the above.

(iv) Which of the following describes the initial handshake process in TCP?
(a) SYN-SYN/ACK-ACK (b) SYN-ACK-ACK
(c) ACK-SYN-SYN/ACK (d) ACK-ACK/SYN-SYN

(v) Which is the correct order when data is encapsulated?
(a) Data, frame, packet, segment, bit (b) Segment, data, packet, frame, bit
(c) Data, segment, packet, frame, bit (d) Data, segment, frame, packet, bit.

(vi) Which of the following statements is FALSE regarding a bridge?
(a) Bridge is a layer 2-device
(b) Bridge reduces collision domain
(c) Bridge is used to connect two or more LAN segments
(d) Bridge reduces broadcast domain.

(vii) What is the maximum size of data that the application layer can pass to TCP layer?
(a) Any size (b) 2^16 bytes-size of TCP header
(c) 2^16 bytes (d) 1500 bytes.

(viii) A network 192.168.50.0/27 is subnetted. What is the number of valid host addresses per subnet?
(a) 16 (b) 30 (c) 32 (d) 62

(ix) Which of the following statements is true about a switch?
(a) Switch operates at the Network Layer
(b) Switch divides the collision domain for each port
(c) Switch reduces broadcast domain
(d) Switch cannot learn MAC addresses

(x) In the OSI model, which layer is responsible for end-to-end communication and error recovery?
(a) Network Layer (b) Transport Layer
(c) Session Layer (d) Data Link Layer

Fill in the blanks with the correct word

(xi) Vulnerable time of slotted aloha is (where T_{fr} is the frame transmission time) _____.

(xii) A _____ topology provides multiple redundant paths between devices, enhancing fault tolerance.

(xiii) A _____ is used to connect and manage multiple network segments, making forwarding decisions based on MAC addresses.

(xiv) RIP uses _____ as its metric to determine the best path for routing packets.

(xv) UDP is a _____ protocol, meaning it does not guarantee the delivery of data packets.

Group - B

2. (a) Let the generator polynomial $g(x) = x^3+x^2+1$ and information bits are 110110. Find the CRC. Can g(x) detect single errors? Double errors? Triple errors? If not, give an example of an error pattern that cannot be detected? *[(CO2)(Analyse/IOCQ)]*

(b) If we have a generator polynomial G(x) having a factor (x+1), we can detect all errors of odd number of bits. Justify *[(CO2)(Analyse/HOCQ)]*

9 + 4 = 12

3. *(a)* Explain the functions of network layer and transport layer in brief. *[(CO1)(Remember/LOCQ)]*

(b) Let the received codeword be 110110101110. Using Hamming code try to correct the codeword if single bit error has occurred. *[(CO2)(Apply/IOCQ)]*

(c) What are the criteria to select generator polynomial (g(x)) to detect all single bit error in CRC? *[(CO3)(Understand /LOCQ)]*

(3 + 3) + 4 + 2 = 12

Group - C

4. (a) Let nf is the number of bits in the information frame including n_0 number of overhead bits, n_a is the number of bits in the ACK frame and R is the bit rate of the transmission channel, and d is the propagation delay. Calculate the efficiency of Stop-and-Wait ARQ in the system. (Assume that P_f is the probability that a frame transmission has errors and needs to be retransmitted). *[(CO3)(Analyse/HOCQ)]*

   (b) Show the bit stream transmitted by the HDLC protocol, if message to be transmitted is: 101111111011111101010. *[(CO3)(Apply/IOCQ)]*

   (c) Prove that the minimum frame site in Ethernet is 64 Byte. *[(CO3)(Analyse/HOCQ)]*

6 + 2 + 4 = 12

5. (a) Suppose we are transmitting frames between two nodes using Stop-and-Wait protocol. The frame size is 3000 bits. The transmission rate of the channel is 2000 bps (bits/second) and the propagation delay between the two nodes is 100 milliseconds. Assume that the processing times at the source and destination are negligible. Also, assume that the size of the acknowledgement packet is negligible. Calculate the channel utilization for the above scenario in percentage. *[(CO3)(Analyse/HOCQ)]*

   (b) A sender uses Go-Back-N ARQ with window size = 4. The sequence number field is 3 bits. How many frames can be sent before waiting for ACK? What is the maximum number of unacknowledged frames allowed? *[(CO3)(Apply/LOCQ)]*

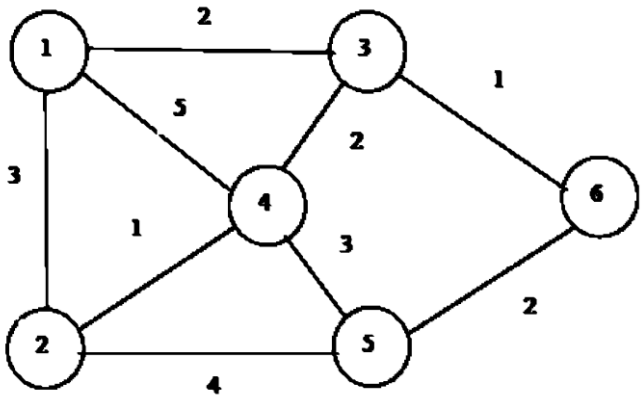
   (c) A network uses a 6-bit sequence number for Selective Repeat ARQ. What is the maximum sender window size? Justify your answer. *[(CO3)(Analyse/HOCQ)]*

5 + 3 + 4 = 12

Group - D

6. (a) Suppose a router receives an IP packet containing 600 data bytes and has to forward the packet to a network with maximum transmission unit of 200 bytes. Assume that the IP header is 20 bytes long. Show the fragments that the router creates and specify the relevant values in each fragment header (i.e., total length, fragment offset, and flag bits). *[(CO4)(Apply/IOCQ)]*

   (b) Give the routing table for node 6 using distance vector routing algorithm.



[(CO5)(Apply/IOCQ)]

6 + 6 = 12

7. (a) What do you mean by supernetting? *[(CO4)(Understand/LOCQ)]*

(b) Three subnets have the following network prefixes: 57.6.96.0/21, 57.6.104.0/21, 57.6.112.0/21, and 57.6.120.0/21. If these network prefixes are aggregated into a single route, what will be the aggregated network prefix and the mask? *[(CO4)(Apply/IOCQ)]*

(c) Distinguish between adaptive routing and fixed routing. Why adaptive routing is preferred over fixed routing? *[(CO5)(Understand/LOCQ)]*

(d) What is the purpose of subnetting? Find the net id and the host id of the following IP addresses:
(i) 172.34.21.5 (ii) 220.34.8.9 *[(CO4)(Apply/IOCQ)]*

2 + 3 + 3 + 4 = 12

Group - E

8. (a) Consider an instance of TCP's Additive Increase Multiplicative Decrease (AIMD) algorithm where the window size at the start of the slow start phase is 2 MSS and the threshold at the start of the first transmission is 8 MSS. Assume that a time out occurs during every fifth transmission. Find the congestion window size at the end of the 14th transmission (draw a suitable graph to explain your answer). *[(CO6)(Analyze/IOCQ)]*

(b) Write short note on: (i) DHCP (ii) FTP. *[(CO6)(Remember/LOCQ)]*

6 + (3 + 3) = 12

9. (a) A leaky bucket is used with an output rate of 2 MB/s. An input burst of 10 MB arrives in 2 ms.
(i) How much data can be sent out immediately?
(ii) How long will it take to send the remaining data?
(iii) How much data is discarded if the bucket size is 5 MB? *[(CO6)(Apply/IOCQ)]*

(b) Suppose TCP uses slow start and the congestion window is initially 1 MSS. The threshold value is 16 MSS.
(i) Show how the congestion window changes over 10 rounds of transmission.
(ii) What happens if a timeout occurs in the 7th round? *[(CO6)(Apply/IOCQ)]*

(c) How the backpressure does help in congestion control? *[(CO6)(Understand/LOCQ)]*

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

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	25	52.08	23.96