Indian Institute of Technology Kharagpur
Dept. of Computer Science & Engineering

Mid-Semester Examination, Spring 2022-23

Subject No.: CS31204/CS31006 **Subject Name: Computer Networks**
Time: 2 Hours **Full Marks: 60**

Answer ALL five questions

1. (a) What is the highest data transfer rate that can be achieved with a line having a signal-to-noise ratio of 100 and a bandwidth of 4000 KHz? Show your calculations. (2)

(b) A network supports a maximum data rate of 10 Mbps; however it is used to pass only an average of 12,000 frames per minute with each frame carrying an average of 10,000 bits. What is the throughput of this network? (2)

(c) If the bit stream 00111111100011110111000111111 is to be transmitted with a preamble of 01111110, what will be the final bit stream transmitted (not including the preamble)? No explanation is needed. (2)

(d) Suppose that 7 senders are sending to 7 different receivers using Synchronous TDM. The TDM scheme is using bit multiplexing with 1 framing bit (synchronization bit) in each TDM frame. Each sender wants to send 5 KB data to the corresponding receiver. However, 5 of the senders are sending data at 10 Kbps, and 2 are sending at 5 Kbps.

(i) What should be the minimum data rate supported by the TDM link? (1)

(ii) What is the efficiency of the system (ratio of total data bits transmitted to total bits transmitted)? Show all calculations with justification. (5)

2. (a) A bit stream 1010001101 is to be transmitted with CRC used for error detection. The generator pattern for CRC is 110101. What is the final bit stream sent? Show all calculations. (6)

(b) Suppose that we send 64 bytes of data, with checksum used for error detection. The word length used in checksum is 16 bits. If two 16-bit words are swapped in the bit stream during transmission, can the checksum detect this error? Justify briefly. (2)

3. (a) Explain with an example why in a Selective Repeat (Selective Reject) ARQ scheme with 3-bit sequence numbers, the window size cannot be more than 4. (4)

(b) Consider a sliding window flow control system with window size of 6 frames. Each data frame is of size 64 bytes. Each acknowledgement frame is of size 8 bytes. The transmission rate of the sender is 100 Mbps. The length of the link is 10 km and the propagation speed is 2×10^8 meters/sec. What is the approximate line efficiency of the system? Show all calculations with justification. Assume that acks are sent for individual frames, there is no timeout/error, the sender always has enough frames to

send, and processing delays at sender and receiver are negligible. What should be the window size to get 100% efficiency? (8)

4. (a) Explain how a frame is sent by a node in a system using CSMA/CA system, including how collisions are detected and handled. (6)

(b) Suppose that two machines A and B want to communicate with each other in a CSMA/CD scheme using p-persistent CSMA, with $p = 0.4$. If both machines sense the medium to be free at the same time at beginning of time slot 0, what is the probability that exactly one process will transmit in time slot 0? Assume that a machine gives up after 3 collisions and the time for sensing the channel, detecting collision, processing etc. is negligible compared to the slot time. Show all calculations with justifications. (8)

5. (a) Explain clearly why there is no collision in a full-duplex switched Ethernet. (4)

(b) Explain step-by-step how an Ethernet packet is processed by a receiver in a TCP/IP network. (5)

(c) Suppose you are given five 8-port switches. What is the maximum number of machines you can connect with them? Justify briefly. (3)

(d) Can you do reliable communication across a link using Ethernet? Justify. (2)