N COE 768: Mid-Term Test

2018

- There are **Five** questions. Answer **ALL** of them. The points assigned to the questions are indicated at the beginning of the questions. The total points of this paper are 100.
- If doubt exists as to the interpretation of any question, the student is urged to submit with the answer paper, a clear statement of any assumption made.
- Time limit: 1 hour 50 minutes.

Student Name:

Student ID:

Question	Marks
Question 1 (20%)	
Question 2 (10%)	
Question 3 (25%)	
Question 4 (20%)	
Question 5 (25%)	
Total (100%)	

Question 1

A transmission system has the following parameters:

- NRZ-I encoding.
- Start delimiter (SD) is represented by 11111101.
- End delimiter (ED) is represented by 00000000.

a) **(10 points)** Based on the above information, design the most efficient bit-stuffing strategy to provide data transparency. Your design should specify at what situation a stuffed bit should be inserted in the data stream and the value of the stuffed bit (1 or 0).

b) **(10 points)** Based on your answer in part (a), sketch the NRZI waveform that represents the following binary data: 11111111 00000000.
Note 1: assume the first bit is represented by a positive pulse.
Note 2: Do not include SD and ED in your sketch.

Question 2

(10 points) Given the following generator polynomial:

$$G(x) = x^4 + x^2 + 1,$$

determine the FCS for the following binary data: 10011001

Problem 3 (25 points)

Computer A is communicating with Computer B over a physical link using connection-oriented data-link protocol with the following parameters:

- 4-bit sequence field (N(S)) and 4-bit acknowledgement (N(R)) field;
- Go-Back-n is adopted as the sliding window mechanism;
- Maximum sending window size is 8.
- It takes less than 1 msec to send and process a frame;
- The round-trip propagation delay is 1 msec;
- Piggybacking and negative acknowledgement are employed;
- The retransmission time-out period is 10 msec.

The sending and the receiving windows of Computer A have the following values:

$$S_f = 14;\ S_n = 5; R_n = 7$$

Consider the following sequence of events:

1. At t=0, Computer A receives an error-free data frame from Computer B with N(S)=7 and N(R)=15.
2. At t= 5 msec, Computer A prepares to send 4 data frames to Computer B.
3. At t= 10 msec, Computer A receives an erroneous data frame from Computer B.
4. At t= 13 msec, Computer A receives an error-free data frame from Computer B. with N(S)=8 and N(R)=6.

Based on the above sequence of events, answer the following questions:

a) Determine the values of S_f, S_n and R_n of Computer A after the frame received at event 1 is processed.
b) Derive the content(s) of the header(s) of the frame(s) sent by Computer A between events 2 and 3.
c) Derive the content(s) of the header(s) of the frame(s) sent by Computer A between events 3 and 4.
d) Derive the content(s) of the header(s) of the frame(s) sent by Computer A right after event 4.

Note: The content of the header should include the frame type (Data, Ack or Negative Ack) and N(R) field and in some cases the N(S) field.

Question 4 (20 points)

A data-link layer that supports the communication between two computers over a physical link has the following parameters:

- Link distance =100 km;
- Channel data rate = 100 Mbps;
- Error Control Protocol: Selective Repeat
- Maximum Frame size = 12000 bits
- Signal propagation speed = 2×10^5km/sec

a) Determine the minimum number of bits required to represent the sequence number of the frame.
b) According to your answer in part (a), determine the size of the buffer required at the datalink layer. You can make any reasonable assumption to derive the answer.

Problem 5 (25 points)

In lab 5, you implemented a file transfer application based on UDP. The application, however, only support file download. Enhance the implementation by adding the file upload capability. You can freely add new PDU type(s). You only need to show the parts of the server and client programs that are relevant to the "upload" feature.