COE 768: Mid-Term Test

2016

- There are **Four** 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.

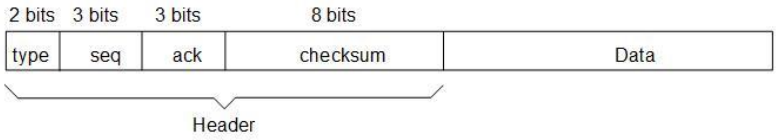
Student Name:

Student ID:

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

Question 1

Two stations, A and B, exchange information over a physical link. A data-link protocol based on go-back-n sliding-window protocol is used for the error-control. The following figure shows the frame format of the protocol.



The seq and ack are sequence and acknowledgement numbers, respectively. The type field indicates the type of frame. For data frames, the type field value is 10. The checksum is derived using 1's complement method and is used to check the transmission error of the complete frame (Header plus the Data fields). Finally, the frame is transmitted using 4B/5B coding with MLT-3.

a) **(10 points)** Suppose station A prepares to send two bytes of data with values 01111110 00000011 to station B. Station A has the following window pointers:

$S_n = 3$, $S_f = 2$, $R_n = 2$.

Determine the content of the frame, including header and Data fields, sent by station A to station B.

b) **(8 points)** Sketch the transmitted waveform corresponding to the header portion of the frame in part (a), assuming the first bit has a positive polarity.

4B/5B Table

4-bit data	5-bit symbol	4-bit data	5-bit symbol
0000	11110	1000	10010
0001	01001	1001	10011
0010	10100	1010	10110
0011	10101	1011	10111
0100	01010	1100	11010
0101	01011	1101	11011
0110	01110	1110	11100
0111	01111	1111	11101

c) **(7 points)** Comment on how 4B/5B coding solve the issues of frame and bit synchronizations.

Problem 2 (25 points)

Computer A is communicating with Computer B over a physical link using HDLC protocol which has the following parameters:

- 3-bit sequence field (N(S)) and 3-bit acknowledgement (N(R)) field;
- Go-back-n is adopted as the sliding window mechanism;
- It takes less than 1 msec to send and process a data frame;
- The round-trip delay is 2 msec.

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

$$S_f = 6;\ S_n = 3; R_n = 5$$

Consider the following sequence of events:

1. At t=0, Computer A receives an error-free data frame from Computer B with N(S)=5 and N(R)=7.
2. At t=20 msec, Computer A prepares to send 4 data frames to Computer B.
3. At t=40 msec, Computer A receives an erroneous data frame from B.
4. At t=50 msec, Computer A receives an error-free data frame with N(S)=6 and N(R)=5.

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

a) Derive the content(s) of the header(s) of the frame(s) sent by Computer A between events 2 and 3.
b) Derive the content(s) of the header(s) of the frame(s) sent by Computer A between events 3 and 4.
c) 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 "type" and N(R) fields and in some cases the N(S) field.

Question 3

You are requested to design a communication system that supports the communications between two servers over a communication link with the following parameters:

- Round Trip delay = 1 msec;
- Channel data rate = 100 Mbps;
- Channel bit-error-rate = 10^{-12}.

Your design should satisfy the following criteria:

- Data frame size, including header and 4-byte FCS, must not be greater than 1000 bytes;
- Link Efficiency must be at least 95%;
- Minimizing system complexity.

Answer the issues below in your design:

a) **(10 points)** Error-Control protocol – Choose one of the three connection-oriented error control protocols: Stop-and-Wait, Go-Back-n and Selective Repeat.

b) **(7 points)** The number of bits used for the sequence number in the data frames.

c) **(4 points)** The maximum size of the data frame.

d) **(4 points)** The sizes (in bytes) of both receiving and transmitting buffers.

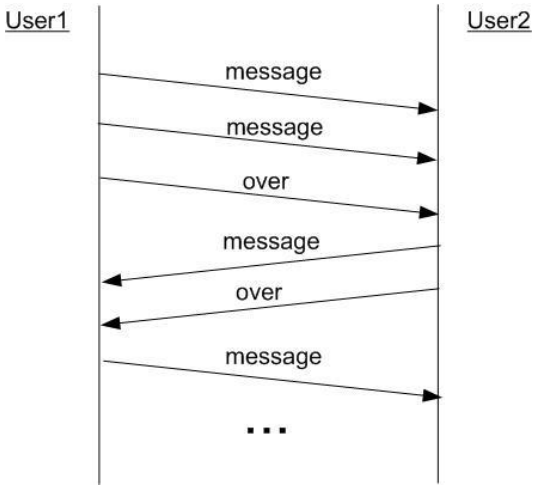
You **must provide enough justifications** to support your design.

Problem 4 (25 points)

Implement a network application over which two users can chat on line. The application must satisfy the following requirements:

a. Only one user can talk (send message) at any given time, similar to walkie talkie.
b. When a user finishes talking, he/she will send an "Over" message to signal that it is the other side's turn to talk.
c. The side that initiates the chat will talk first.
d. The application uses TCP as the transport protocol.

The following diagram illustrates an example of PDU exchanges between user1 and user2.



Write the program that implements the side that initiates the chat connection. You can make the assumption that the sockets have been setup properly and you only need to show the part of the program that is relevant to the chat application.