May 30, 2002

COMPUTER ENGINEERING DEPARTMENT

COE 342

DATA & COMPUTER COMMUNICATIONS

Final Exam

Second Semester (012)

Time: 7:00-9:30 PM

Student Name : _____

Student ID. : _____

Question	Max Points	Score
Q1	24	
Q2	16	
Q3	8	
Q4	6	
Q5	18	
Q6	18	
Q7	10	
Total	100	

Dr. Aiman El-Maleh

[24 Points]

(Q1) For each of the following questions, select the correct answer:

(1) The sharing of a medium and its path by two or more devices is called

a. modulation
b. encoding
c. line discipline
d. multiplexing

(2) Which multiplexing technique transmits digital signals?

a. FDM
b. Synchronous TDM
c. Statistical TDM
d. b and c

(3) Piggybacking is a technique that _____

a. inserts additional bits in the information field of a frame to allow the presence of arbitrary bit patterns after the flag field
b. sends positive and negative acknowledgment in separate frames known as supervisory frames
c. sends positive and negative acknowledgment along with information in the same frame
d. compresses and decompresses the frame to increase line utilization

(4) In a sliding window protocol with a 3-bit frame sequence number, the maximum window size is _____

a. 3
b. 4
c. 7
d. 8

(5) In synchronous TDM, frame synchronization is achieved by

a. a flag in the beginning and end of a frame like in HDLC protocol.
b. one control bit added to each TDM frame creating an identifiable pattern of bits from frame to frame.
c. SYNC characters bracketing TDM frames.
d. none of the above.

(6) In statistical TDM, for n signal sources, each frame contains m slots, where m is usually

a. less than n
b. greater than n
c. equal to n
d. half of n

(7) For stop-and-wait flow control, for n data packets sent, _____ acknowledgments are needed.

a. one
b. n
c. from 1 to n
d. none of the above

(8) A timer is set when _____ is sent out

a. a frame
b. an ACK
c. a NAK
d. all of the above

(9) In HDLC frame, the address field is _____

a. one byte
b. two bytes
c. four bytes
d. any number of bytes

(10) Flow control is needed to prevent

a. overflow of the sender's buffer
b. overflow of the receiver's buffer
c. waiting
d. a and b

(11) Which type of HDLC frames is used to establish a connection?

a. Information frames
b. Supervisory frames
c. Unnumbered frames
d. a and b

(12) A _____ is any device that transmits or receives data in the form of an analog or digital signal through a network.

a. DTE
b. DCE
c. a and b
d. none of the above

(13) EIA-232 defines the mechanical, electrical, functional, and procedural characteristics of the interface between _____

a. two communicating DTEs
b. two communicating DCEs
c. a DTE and DCE
d. none of the above

(14) A null modem connects _____

a. a DTE with a DCE
b. two close DCEs that do not require a network
c. two DCEs across public switched telephone network
d. two close DTEs that do not require a network

(15) The Request to Send signal is asserted when _____

a. a DCE wishes to transmit
b. a DTE wishes to transmit
c. a DCE requests a DTE to transmit
d. a DTE requests a DCE to transmit

(16) The Clear to Send signal indicates that _____

a. the DTE is ready to send
b. the DCE is ready to send
c. the DTE is ready to receive
d. the DCE is ready to receive

(17) Pulse stuffing is a technique used to

a. provide frame synchronization
b. raise the data rate of a given source to a desired rate
c. to allow the presence of arbitrary bit patterns after the flag field
d. none of the above

(18) If station A sends a DISC command to terminate a logical link connection, station B will acknowledge this by sending

a. Disconnected mode (DM)
b. Unnumbered acknowledgment (UA)
c. Request disconnect (RD)
d. none of the above

(19) If station A wants to set the mode of communication such that it is the primary and that station B is a secondary and can only transmit data in response to commands from A using 3-bit frame sequence numbers, then station A sends the command

a. SNRM
b. SNRME
c. SARM
d. SABM

(20) In balanced transmission, signals are transmitted using _____

a. one conductor
b. two conductors
c. four conductors
d. none of the above

(21) In an asynchronous private line modem the following two pins are not needed _____

a. DCE Ready and Ring Indicator
b. DTE Ready and Ring Indicator
c. DCE Ready and DTE Ready
d. Request to Send and Clear to Send

(22) In a dialup operation through the telephone network, the DTE ready pin is asserted when _____

a. DTE wants to tell its DCE it wants to begin a data exchange
b. there is a Ring Indicator signal coming from DCE and the DTE is ready to respond
c. a and b
d. none of the above

(23) Using CRC-16 for generating the FCS, it is guaranteed that all _____ are detected.

a. single bit errors
b. double bit errors
c. burst errors of length less than 16
d. all the above

(24) Line utilization increases by _____.

a. increasing the transmitted frame length
b. reducing transmission data rate
c. reducing the distance between transmitter and receiver
d. all the above

[16 Points]

(Q2) Assume that Cyclic Redundancy Check is employed for error detection. Assume that the message size is 8 bits and the divisor used is P=110011.

(i) What are the size of the FCS and the size of the transmitted frame?

(ii) What is the polynomial of the used divisor?

(iii) Draw the linear feedback shift register (LFSR) circuit that generates the FCS.

(iv) Given that the message M=11100011, using division, determine the FCS and the transmitted frame.

(v) Verify that the LFSR circuit generates the same FCS obtained in (iv).

(vi) Explain how the receiver decides whether the received frame is faulty or fault-free.

[8 Points]

(Q3) Consider the use of 2000 bit frames on a 1 Mbps satellite channel with a 250 ms propagation delay. Determine the maximum link utilization for each of the following cases:

(i) Stop-and-wait flow control.

(ii) Sliding-window flow control with a window size of 7.

(iii) Stop-and-wait ARQ, given that the expected number of transmissions per frame is 1.2.

(iv) Selective ARQ with a window size of 7, given that the expected number of transmissions per frame is 1.2.

[6 Points]

(Q4) In HDLC frames, the 8-bit pattern 01111110 is used as a flag.

(i) Explain what is the benefit of using the flag in HDLC frames.

(ii) HDLC protocol uses a procedure known as bit-stuffing. Explain why this procedure is used.

(iii) Suppose that the following data pattern is to be transmitted in the information field of an HDLC frame. Determine the content of the information field after bit stuffing.

11111111111101111111011111110

[18 Points]

(Q5) Suppose that station A established an HDLC connection with station B and operated for some time. At time t, the last frame sent by A to B was F_9, the last acknowledged frame is F_5, and the current window for station A is $W_A=\{F_{10},...,F_{15}\}$, i.e. the first frame in W_A is F_{10} and the last frame is F_{15}. Answer the following questions, assuming that each question is independent of the others.

(i) Determine the window size. What is the minimum number of bits used for the frame numbers?

(ii) Assume that at time t, station A received RR 8 from station B. Update the window W_A by showing its first and last frame. Which frame station A will transmit next?

(iii) Assume that at time t, station A received RNR 10 from station B. Update the window W_A by showing its first and last frame. What action should be taken by station A?

(iv) Assume that at time t, station A received REJ 7 from station B. What action should be taken by station A?

(v) Assume that at time t, station A received SREJ 7 from station B. What action should be taken by station A?

(vi) Assume that frame F_7 is lost while all other transmitted frames arrived at station B. What action should be taken by station B, assuming Go-Back-N ARQ?

(vii) Assume that all sent frames arrived at station B, and that station B sent RR 10 but this acknowledgment is lost and did not arrive at station A. What action should be taken by station A?

(viii) Assume that frame F_9 arrived with errors at station B. What action should be taken by station B, assuming Selective Reject ARQ?

[18 Points]

(Q6)

(i) Ten 9600 bps lines are to be multiplexed using TDM. Ignoring overhead bits, what is the total capacity required for synchronous TDM? Assuming that we wish to limit average line utilization to 0.8, and assuming that each line is busy 50 percent of the time, what is the capacity required for statistical TDM?

(ii) Assume that it is required to design a TDM PCM system to accommodate four 300 bps synchronous digital inputs and one analog input with a bandwidth of 500 Hz. Assume that the analog samples will be encoded into 4-bit PCM words. What is the capacity required for the TDM output line? Suppose that the multiplexing technique allocates 200 bits per frame for the analog signal. How many bits are allocated per frame for each digital input and what is the frame size? Draw a block diagram of the transmitter of the designed TDM system.

(iii) The information in five analog signals is to be multiplexed and transmitted over a telephone channel that has a 400- to 3100 Hz bandpass. Each of the analog baseband signals is bandlimited to 540 Hz. Design a communication system (i.e. show the block diagram of the transmitter and receiver) that will allow the transmission of these five sources over the telephone channel using frequency-division multiplexing with SSB (single sideband) amplitude-modulated subcarriers. Indicate the carrier frequencies that will be used. Assume that the lower sideband will be used.

[10 Points]

(Q7) A message is transmitted using NRZI coding at a rate of 100 Mbps.

(i) Suppose that the transmission is asynchronous using 7 data bits, an even parity bit, and a single stop bit. Determine the range of the clock frequency of the receiver under which no framing error (i.e., no wrong sampling) will occur.

(ii) Suppose that the transmission is synchronous. Assume that the error in the timing of the receiver accumulates at a rate of 0.1 ns for each bit. How long does it take for the receiver to make wrong sampling at the edge of the bit time? What is the transmitted data pattern that could cause this wrong sampling?