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| **Instructor:** | **Computer Science** | **7 - 9 pm, Friday,** |
| **Dr. James W. Hong** | **CS357b** | **February 17, 1995** |
| | **Midterm Exam** | |

**Student Name:** **Number:**

1. Answer True or False. [17 marks]

[ ] (a) The telephone network service was designed to receive, switch and transmit analog signals in the voice-frequency range of about 300 to 3400 Hz.

[ ] (b) Each signaling element is less than one bit when Manchester encoding is used.

[ ] (c) Two problems that an FDM system must cope with are intermodulation noise and crosstalk.

[ ] (d) Statistical TDM requires a higher data rate to support as many devices as synchronous TDM.

[ ] (e) Examples of DTEs are computers and terminals.

[ ] (f) LRC is an error correction mechanism.

[ ] (g) With Go-back-N error control protocol, it is not required that each individual frame be acknowledged.

[ ] (h) Bit stuffing is used in HDLC.

[ ] (i) In roll-call polling, the primary selectively polls each secondary in a fixed order.

[ ] (j) When the bit length of the link is greater than the frame length, multiple frames can be in transit at one time.

[ ] (k) Stop-and-Wait, Go-back-N and Selective-reject are examples of continuous ARQ.

[ ] (l) In Fixed routing, it is sufficient to know, for each pair of nodes, the identity of the first node on the route.

[ ] (m) HDLC uses 16, 32 or 64 bits for FCS.

[ ] (n) Frequency is the number of repetitions of the period per second.

[ ] (o) The spectrum of a signal is the number of frequencies that it contains

[ ] (p) If the data rate of the digital signal is N bps, then a very good representation can be achieved with the bandwidth of N/2 Hz.

[ ] (q) The information field is present only in I-frames and some unnumbered frames in HDLC.

2. Synchronous and asynchronous transmission are simple techniques used for digital data communication.

(a) Generate the transmitted bit pattern of a character string "ABCD" based on the following assumptions: [4 marks]

- asynchronous transmission
- 7-bit ASCII code plus a parity bit (odd parity)
- one start (binary 0) and one stop bit (binary 1)
- LSB is transmitted first
- the ASCII code for 'A' is 65

(b) What is the communication overhead (in %) for the above transmission? Show your calculation. [2 marks]

3. (a) Given a message M = 1010001101, determine the CRC checksum using the polynomial $P = x^5 + x^4 + x^2 + 1$. Show your work. [4 marks]

(b) What is the transmitted message T? [1 mark]

(c) How does the receiver check whether the message T was transmitted without any errors? [2 marks]

4. (a) Is it possible for a synchronous TDM device to handle sources of different data rates? If so, describe a scheme to achieve that? [2 marks]

(b) Describe a situation when synchronous TDM does not fully utilize the available bandwidth of the medium. [2 marks]

(c) Describe how the statistical TDM overcomes the problem mentioned in (b). [2 marks]

5. Flow control is a technique used for assuring that a transmitter does not overwhelm a receiver with data.
(a) How does the receiver prevent the transmitter from sending any more frames in the Stop-and-Wait flow control protocol? [2 marks]

(b) How does the receiver prevent the transmitter from sending any more frames in the Sliding-Window flow control protocol? [2 marks]

(c) Describe the following cases with respect to the link utilization when the Sliding-Window flow control protocol is used. Assume $N$ is the window size and $a$ is the ratio of propagation time over transmission time. [4 marks]

**(i)** $N > 2a + 1$

**(ii)** $N < 2a + 1$

6. (a) Name and describe two types of frame errors that occur in the transmission of frames. [4 marks]

(b) After transmitting several frames, the transmitter receives a NAK $i$ frame. Describe how the transmitter reacts in the following error control protocols. [4 marks]

**(i)** Go-back-N

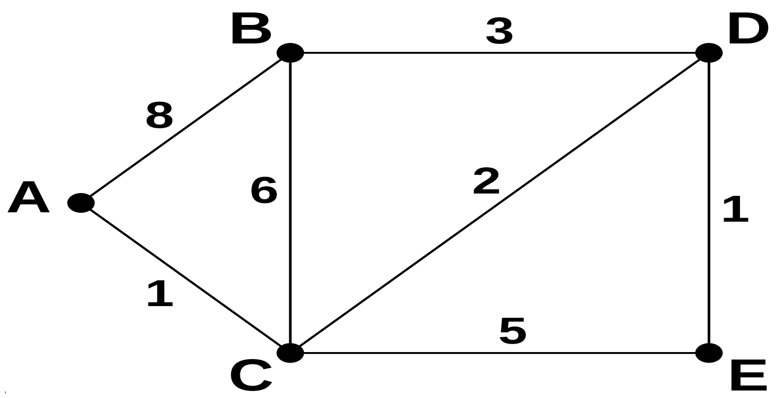
**(ii)** Selective-reject

(c) Describe what happens if a NAK is lost during transmission in the Go-back-N error control protocol. [2 marks]

7. (a) Imagine that you have trained your St. Bernard, Bernie, to carry a box of three floppy disks instead of a flask of brandy. (When your disk fills up, you consider that an emergency.) These floppy disks each contain 250,000 bytes. The dog can travel to your side, wherever you may be, at 18 km/hour. For what range of distances does Bernie have a higher data rate than a 2400 bps telephone line? Show your calculations. [5 marks]

(b) Television channels are 6 MHz wide. What is the maximum data rate (in bps) that can be achieved if four-level digital signals are used? [3 marks]

8. Fill in the table provided below for the given packet switched network using the Dijkstra's least-cost algorithm discussed in class. Numeric values on links joining the nodes represent the cost of packet transmission on their respective links. [10 marks]




| Iteration | M | Db | Path | Dc | Path | Dd | Path | De | Path |
|---|---|---|---|---|---|---|---|---|---|
| 1 | {A} | | | 1 | A-C | Infinity | — | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | {A,B,C,D,E} | | | | | | | | |