Student Name:

Student Number:

Midterm Examination

308-435B 2001: Basics of Computer Networks

Examiner: Prof. Hans Vangheluwe   Wednesday, February 14th, 2001

Invigilators: Jean-Sébastien Bolduc, Chak Wai So   15:00 – 16:30

INSTRUCTIONS:

1. Answer all questions directly on the examination paper.

2. No aids of whatever type are permitted.

3. The exam has 8 questions on 5 pages (including cover page).

4. Attempt all questions: partial marks are given for incomplete but correct answers.

5. Numbers between brackets [] denote the weight of each question. The total is 40 points.
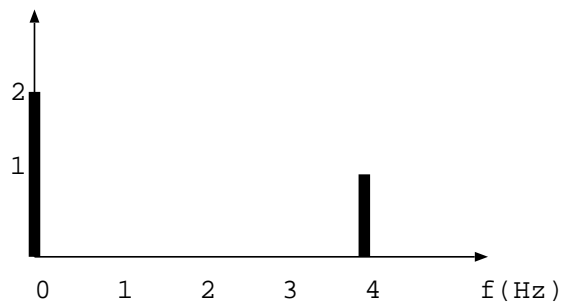
Good luck !

(1) [4]

- What is the purpose of layering in networks ?

- What are the responsibilities of a layer (in general, not specifically data link, network, ...) ?

(2) [3]

Given the frequency spectrum below

- Draw the time-domain equivalent signal. Name axes and provide scale.

- What is the bandwith of the above signal ?

(3) [11]

- Draw the NRZ-L and NRZ-I encodings for the bitstream `01001110`. Assume the signal is positive at time 0:

1. NRZ-L

2. NRZ-I

- Which (NRZ-L or NRZ-I) is better ?

- Why ?

- Draw the Differential Manchester encoding (using the same time-scale as for NRZ-L and NRZ-I) for the above bitstream.

(4) [8]

- Given the DB25 pins below, describe the operation of EIA-232 synchronous *half-duplex* communication. Draw the signal sequence to the right of the pin list. Write your description below the list.
    1. Shield
    2. Transmitted data
    3. Received data
    4. Request to send
    5. Clear to send
    6. DCE ready
    7. Signal ground
    8. Received line signal detector
    9. Reserved (testing)
    10. Reserved (testing)
    11. Unassigned
    12. Secondary received line signal detector
    13. Secondary clear to send
    14. Secondary transmitted data

15. Transmitter signal element timing (DCE-DTE)

16. Secondary received data

17. Receiver signal element timing (DCE-DTE)

18. Local loopback

19. Secondary request to send

20. DTE ready

21. Remote loopback and signal quality detector

22. Ring indicator

23. Data signal rate select

24. Transmitter signal element timing (DTE-DCE)

25. Test mode

- Give 3 types of signal impairment. How does the electrical specification for sending data in EIA-232 deal with each ?

    1.

    2.

    3.

(5) [2]

What is the essence of 4-DPSK (dibit) modulation ?

(6) [5]

Given 3 data streams: A (1.5 Mbps), B (4/3 Mbps), and C (2/3 Mbps). Use synchronous Time Division Multiplexing with frames containing 4 1-byte slots + 1 framing bit per frame to transmit these data streams.

1. Which technique needs to be used to properly put the data in the slots ?

2. What is the bitrate (in Mbps) required of the communication channel between MUX and DEMUX ? You may give a (terse) description of your derivation.

(7) [3]

Given m bits of data and a checksum of r bits, derive a necessary relation between m and r for the checksum to be able to correct 1-bit errors.

(8) [4]

- What is a sufficient condition on a CRC generator polynomial $G(x)$ for detecting an odd number of transmission errors ?

- Prove this.