CSS331: Fundamentals of Data Communications
Midterm Mock Exam

curated by The Peanuts

Name.....ID.....Section.....Seat No.....

Conditions: Semi-closed Book

Directions:

1. This exam has 11 pages (including this page).
2. Write your name at the top.
3. Reading the problem is optional, but answering without reading is a bold strategy.
4. Answers must be written in English only
5. Work alone. Collaboration is for your group projects, not exams.
6. Good luck, babe!

For solution, ***click here****.*
Solution will unlock soon.

Question 1

(a) What are the main layers in the TCP/IP protocol suite? List them in order from bottom to top and briefly describe the function of each layer.

(b) Explain the difference between simplex, half-duplex, and full-duplex transmission modes. Give one real-world example for each.

Question 2

(a) A periodic signal has a frequency of 50 kHz. Calculate:

- The period T
- The wavelength if the signal travels at the speed of light ($c = 3 \times 10^8$ m/s)

(b) What is the difference between attenuation and noise? How can each be mitigated in a communication system?

(c) A signal has a spectrum from 2 MHz to 6 MHz.

- What is the absolute bandwidth?
- If this signal experiences attenuation, would you use an amplifier or a repeater to boost it if the signal is (i) analog? (ii) digital?

Question 3

(a) Consider a channel with bandwidth B = 3 MHz and signal-to-noise ratio SNR = 127.

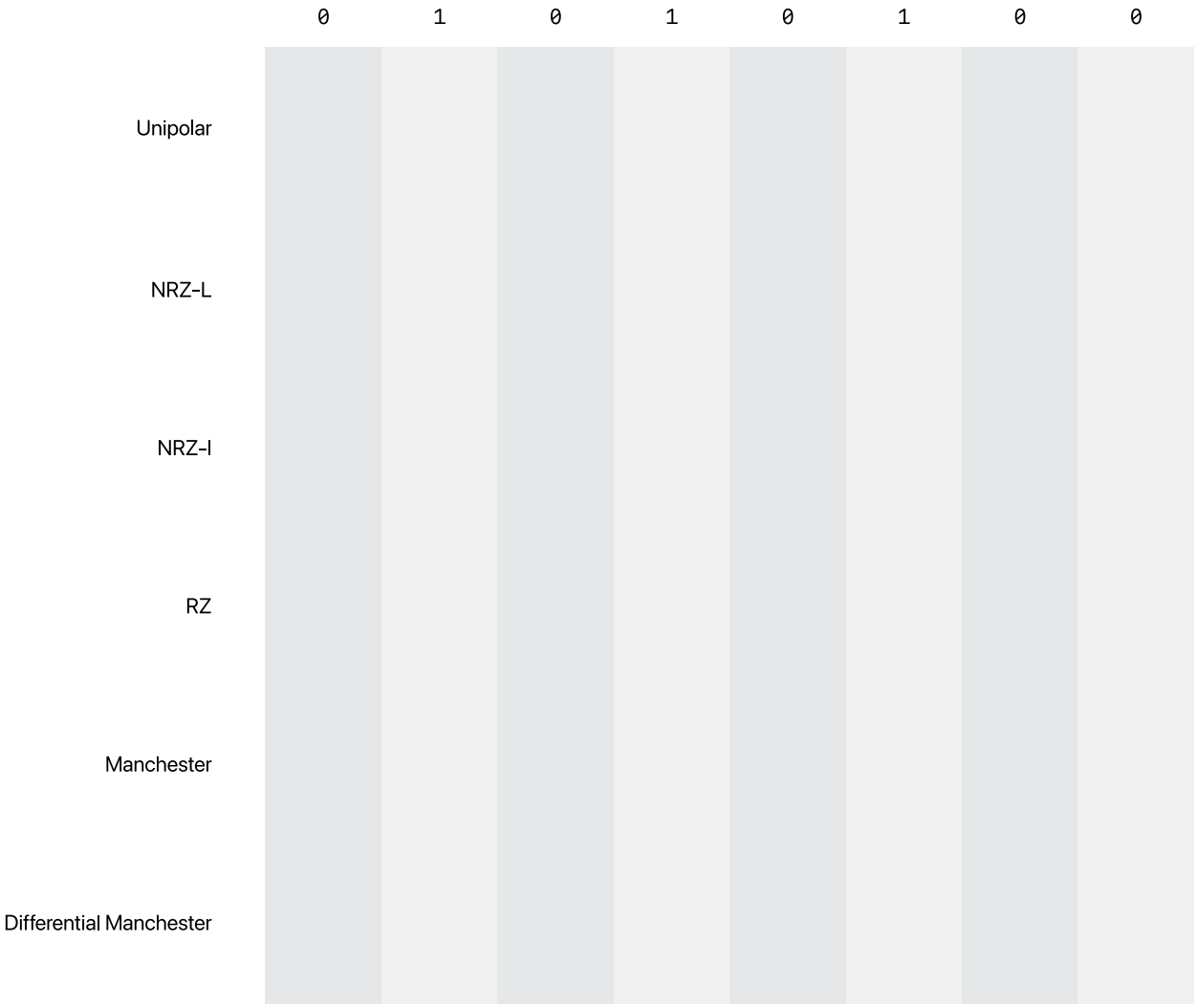
- Calculate the Shannon capacity of the channel.
- Using Nyquist's theorem, how many signal levels M would be required to achieve this capacity?

(b) A voice-grade telephone channel has a bandwidth of 3.4 kHz.

- If we use 16 signal levels, what is the maximum data rate according to Nyquist?
- If the SNR is 30 dB, what is the Shannon capacity? (Note: SNR in dB = $10 \log_{10}(\text{SNR})$)
- Which limit is more restrictive in this case?

Question 4

Draw the waveforms for transmitting the first 8 bits of **"T"** in ASCII (01010100) using the following encoding techniques. Use +V for positive voltage and -V for negative voltage as appropriate.



Question 5

(a) The following data is to be transmitted using even parity VRC:

```
1011001
0110110
1001011
1110101
```

Add the appropriate VRC (parity) bit to each row. Show your work.

(b) Using the data from part (a) (without VRC bits), calculate the LRC (Longitudinal Redundancy Check) using even parity. The transmission is from left to right. Show all steps.

Question 6

Given:

- Data (D): 10110011
- Divisor (P): 10011

(a) Calculate the CRC checksum using binary division. Show all steps of the division process.

(b) What is the transmitted frame (data + CRC)?

Question 7

Given:

- Message M(x) = 1101011
- Generator P(x) = 11001

(a) Express $x^n M(x)$ in polynomial form, where n is determined by the degree of P(x).

(b) Perform polynomial division to find the remainder C(x).

(c) What is the transmitted frame F(x) in binary form?

Question 8

Given 8-bit binary data words:

```
10101100
11001010
11110000
01010101
```

(a) Calculate the checksum using one's complement addition. Show the addition steps.

(b) What is the transmitted frame (data + checksum)?

Question 9

(a) For a data word of 11 bits, how many redundancy bits are needed for single-bit error correction? Show your calculation using the formula $2^r \geq m + r + 1$.

(b) Given the 7-bit data word: 1011001

Calculate the Hamming code with odd parity. Show:

- The position of each redundancy bit
- The calculation of each redundancy bit value
- The final transmitted code.
- Suppose the receiver receives the code `10111010101`. Show how to determine which bit is in error.

Question 10

(a) List three advantages of optical fiber over twisted pair cable.

(b) An FM radio signal has an original bandwidth of 15 kHz. What is the required bandwidth for FM transmission? If this signal is transmitted through free space at 100 MHz, what is its wavelength?