

**Course:** CEG3185  
**Semester:** Summer 2018

**Professor:** Miguel Garzón  
Room: STE 5126B  
Phone: (613)562-5800 x 2129  
Email: mgarzon@uottawa.ca

**Assignment 1**

**Weight: 5%**

**Posted: May 22, 2018**

**Due: June 10, 2018, 23:59 pm**

**Individual Work**

1. **[10 marks]** Find the Fourier series of the square-wave function  $f$  defined by:

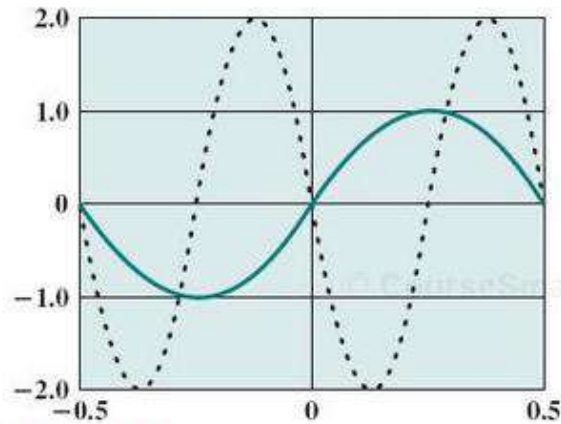
$$f(x) = \begin{cases} 0 & \text{if } -\pi \leq x < 0 \\ 1 & \text{if } 0 \leq x < \pi \end{cases} \quad \text{and} \quad f(x + 2\pi) = f(x)$$

2. **[10 marks]** Find the Fourier series of the rectangular wave defined by:

$$f(x) = \begin{cases} -1 & -\pi \leq x \leq 0, \\ 1 & 0 < x \leq \pi \end{cases}$$

3. **[10 marks]** Consider an audio signal with spectral components in the range 400 to 4200 Hz.
- What is the minimum sampling rate to be used to generate the **PCM** signal? **(2.5 marks)**
  - For quantization noise  $\text{SNR}_{\text{dB}}=36$  dB, what is the number of uniform quantization needed? **(2.5 marks)**
  - What data rate is required? **(2.5 marks)**
  - If the dynamic range of the signal is -5V to +5V, what are the PCM codes for voltage levels -3.3V and +2.9V? **(2.5 marks)**

4. [5 marks] If the solid line, in the figure below, represents  $\sin(2\pi t)$ , what does the dotted curved represent? That is, the dotted curve can be written in the form  $A \sin(2\pi f t + \phi)$ . What are  $A$ ,  $f$  and  $\phi$ ?



5. [10 marks] The command `iwconfig` is used to display and change the parameters of the network interface which are specific to the wireless operation (e.g. interface name, frequency, SSID). It may also be used to display the wireless statistics. The following figure shows the strength of signal and noise for a wireless network.  $P(\text{signal}) = -40$  dBm,  $P(\text{noise}) = -87$  dBm. (dBm = decibel-milliWatts). What are the signal-noise-ratio and the signal-noise-ratio in decibels?

```
$ iwconfig eth1

eth1      IEEE 802.11g  ESSID:"MGARZON"
Mode:Managed  Frequency:2.427 GHz  Access Point: 00:0D:9D:C6:38:2D
Bit Rate=48 Mb/s   Tx-Power=20 dBm   Sensitivity=8/0
Retry limit:7   RTS thr:off   Fragment thr:off
Power Management:off
Link Quality=91/100  Signal level=-40 dBm  Noise level=-87 dBm
Rx invalid nwid:0  Rx invalid crypt:860  Rx invalid frag:0
Tx excessive retries:0  Invalid misc:39  Missed beacon:8
```

6. [10 marks] The standard spectrum of a regular telephone line that is used, via modems, to transmit digital data is 600 to 5000 Hz. The signal-to-noise ratio is 42 dB. What is the capacity of the channel? If we assume that just 80% of the theoretical limit can be reached, derive from the Nyquist formula, the number of signal levels required?

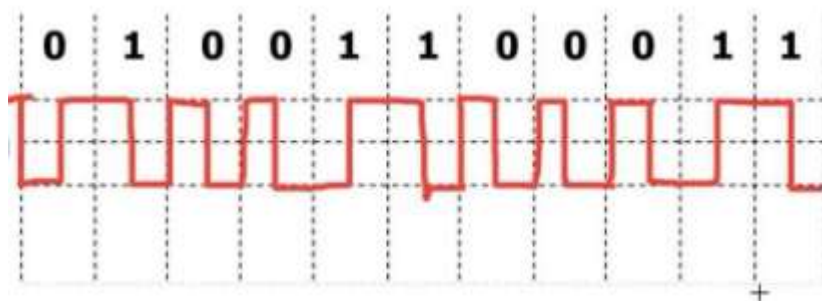
7. [5 marks] The loss in a cable is defined in decibels per kilometer (dB / km). If the signal at the beginning of the cable, with -0.4 dB / km, has a power of 3 mW. What is the signal power at 14 km?

8. [7.5 marks] Complete the following table by specifying the address type for each layer of the TCP / IP model and the name of the PDU (Protocol data unit).

Layer	Protocol Data Unit	Adresse	Exemple of Adresse
Application			
Transport			
Network			
Data Link			
Physical			

9. [17 marks] Encoding techniques

a) What is the encoding technique used in the Figure below. (2.5 points)



b) Use the following encoding schemes to represent **0110000000010011110**. Assume that the polarity of the last pulse is negative (10 points)

- Manchester Différentiel
- HDB3
- B8SZ
- Pseudo-Ternaire
- Manchester

c) For the five encoding techniques above, briefly discuss about their advantages/disadvantages in terms of synchronization, dc component and cost/complexity. (5 points)

10. [5 points] Show the frequency domain of the following signal:

$$S(t) = 2 + 3 \sin 100 \pi t + 5 \sin 200 \pi t$$

### **Bonus (5 points)**

Open the file Attack.pcapng using WireShark, analyze the traffic flow and determine which type of hacking attack is taking place?

*Hint. Wireshark gives you some hints, look at the column 'info'.*