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GENERAL WARNING:

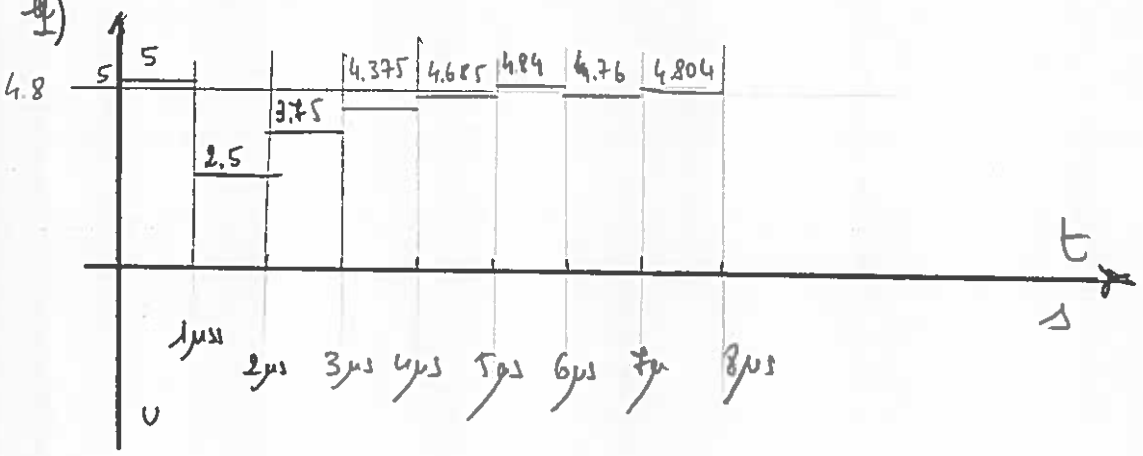
ANSWER THE QUESTIONS WHICH ARE ASKED AND NOT OTHER ONES. ANY COMMENT WHICH IS NOT RELEVANT TO WHAT ASKED **WILL NOT BE CONSIDERED.**

Exercise 1) (max 9 points)

A successive approximations 8 bit A/D converter has a clock of 1 MHz and an input range of 10 V.
If at the input there is a voltage of 4.8V and a conversion is started compute:

1) The sequence of values at the output of the internal D/A converter as a function of the time **(7 points)**
2) The number of cycles required for the conversion **(1 point)**
3) The final digital output voltage **(1 point)**

1)



2) 8 cycles

3) 0111 1011 OUTPUT VALUE

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Exercise 2) (5 points)

A triangular signal with 5kHz frequency is digitalized with a 12 bit AD converter, with an input range of 5 V.

1. Find the SNR when the input signal has peak to peak amplitude of 2.5 V **(2 points)**
2. If the spectrum of the signal may be considered 0 after the 8th harmonic which is the minimum sampling frequency **(3 points)**

1) $SNR_{dB} = 6N - 6 = 6 \cdot 12 - 6 = 66\ dB$

2) $f_{sMin} \geq \underbrace{(5\ kHz * 8)}_{B} * 2 = 80\ kHz$

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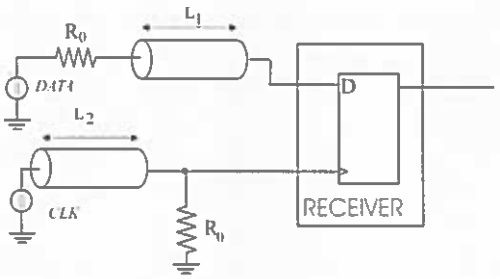
Exercise 3) (8 points)

Given the schematic of the figure, where the parameters of the transmission lines are:
L1 = 35 cm
L2 = 20 cm
v= c/3 (c is the speed of the light).
where the input signals are DATA= 3.3 u(t) and CLK = 3.3 u(t-t_0) and the parameters of the flip-flops are the threshold voltage V_T = 1.7 V and set-up time = 2 ns determine the minimum value of t_0 which will guarantee the correct transmission of the data.



$$t_{DATA} = \frac{35\ cm}{c/3} = \frac{35 \cdot 10^{-2}\ m}{100 \cdot 10^{6}\ m/s} = 3{,}5\ ns$$

$$t_{CLK} = 2\ ns$$

$$t_{CLK} + t_0 \geq t_{DATA} + t_{setup}$$

$$t_0 \geq t_{DATA} + t_{setup} - t_{CLK} = 3{,}5\ ns + 2\ ns - 2\ ns = 3.5\ ns$$

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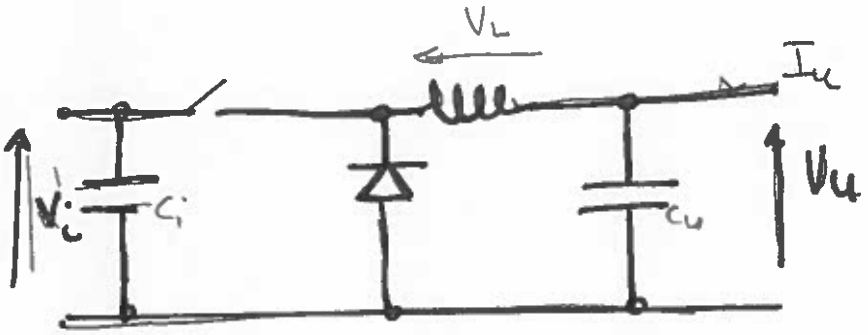
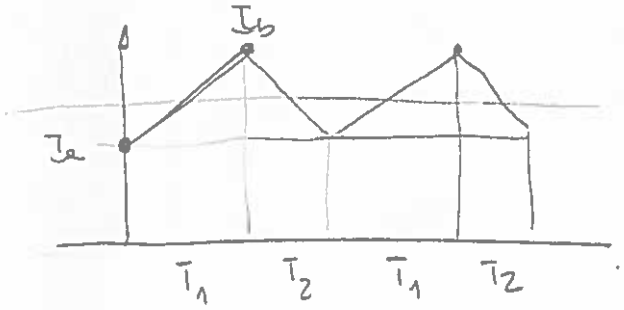
Exercise 4 (8 points)

Draw the schematic of a buck (step-down) power converter **(5 points)**

Compute the the value of the output voltage as a function of the switching frequency, duty cycle and input voltage. **(3 points)**





During T_1 $V_L = V_i - V_u$

During T_2 $= V_L = -V_u$

$$\frac{V_i - V_u}{L} T_1 = -\frac{V_u}{L} T_2$$

$$V_i T_1 = V_u (T_1 + T_2)$$

$$V_u = V_i \frac{T_1}{T_1 + T_2} = V_i D$$

V_u does not depend on the frequency