Assignment 3. MZC 830

Covers: { Tachometer, Absolute encoder.
MEMS sensors
⇒ from chapter 3 sensors.

Chapter 5 Signal processing 5.1 ~ 5.3

Chapter 6. Wheeled mobile Robot

Problem #1

Design an absolute optical encoder with a resolution of 22.5° using straight binary code, please show the schematic drawing of the encoder disk with transparent and opaque areas indicated. [Lecture 16, 17 18. Page 13].

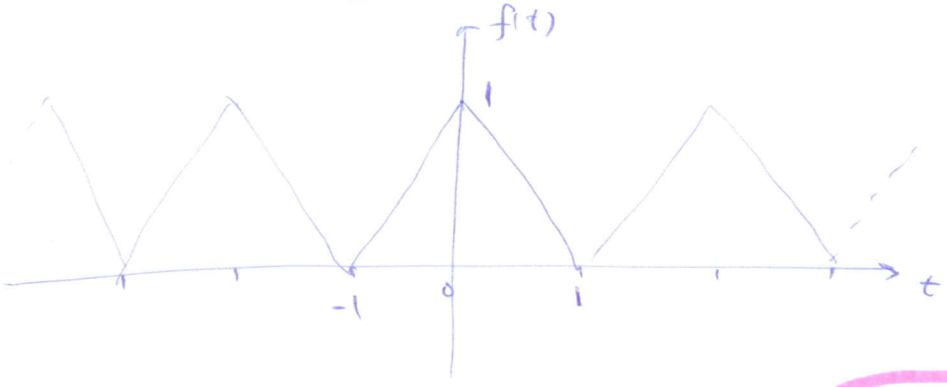
problem #2

What is the fundamental difference between incremental and absolute encoders? ~~what~~ which kind encoder we are using with the Lego system?

problem #3

Use your own words with drawings (if necessary) to explain how a rotation tachometer works.

Problem #4 periodic signal is shown in the fig.



$$f(t) = \begin{cases} 1+t & -1 \le t \le 0 \\ 1-t & 0 < t \le 1 \end{cases}$$ for one period.

1> find Fourier Series of f(t)

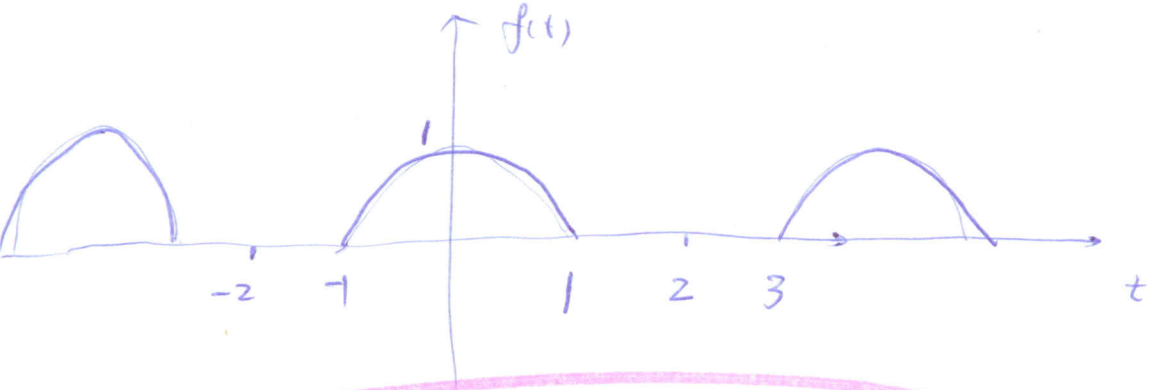
2> Plot Amplitude Spectrum.

3> plot power spectrum.

4> Take the first 11 terms of the ~~Fourier~~ Fourier Series, use ~~Matlab~~ software such as maple, Matlab... to plot the signal in the range of $[-1, \infty\ 1]$

Problem #5

for the periodic wave, one period can be expressed as

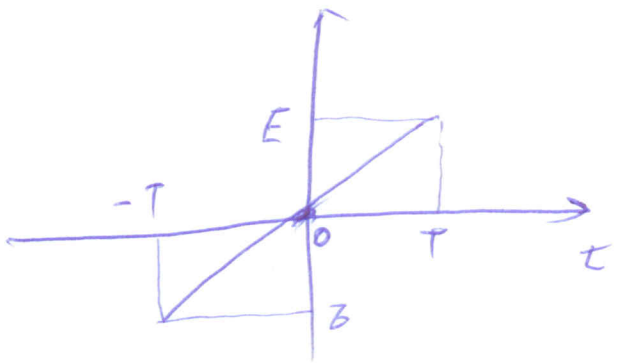


$$f(t) = \begin{cases} \cos\frac{\pi}{2}t & [-1, 1] \\ 0 & [-2, -1] \ \& \ [1, 2] \end{cases}$$

1) find Fourier Series

2) plot Power spectrum

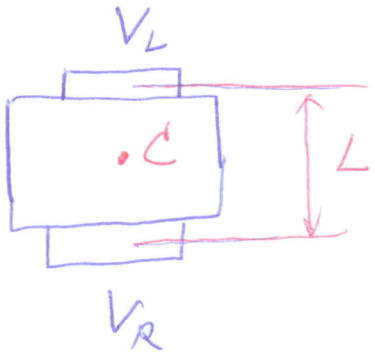
Problem # 6 ① Find Fourier transform of the pulse shown in the Fig. (5)



② if $Z=1$, $T=1$, plot Amplitude spectrum.

③ if $Z=1$, $T=1$, plot Energy spectrum.

Problem #7



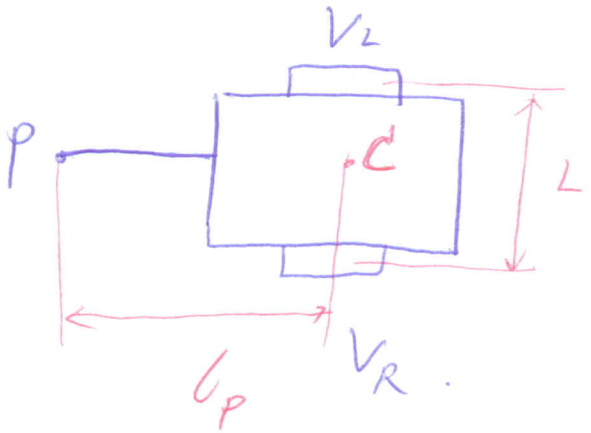
Differential drive wheeled Robot. With ~~parameter~~ L as the distance between the center of two wheels.

(1) Derive ~~the~~ the condition, under which the trajectory of C will be a circle.
[Hint: ~~a~~ condition means ~~how~~ how to set V_R, V_L.)

(2) Relation of R (radius of trajectory of C) to V_R, V_L, L.

(3?) What is the maximum and minimum radius, ~~the point "C"'s trajectory~~ the robot can achieve if the pen is located at "C" point.

Problem #8.



For a differential drive robot, carrying a pen with a distance of L_p from C,

(17) Derive ~~Prove~~ the condition, under which the robot can plot a circle.

2) Relation of R to L_p, L. V_R, V_L.

3) Maximum & minimum R.

R is the radius of the circle plotted by the robot

Problem #7 & #8 can be finished with help of Software such as maple. Matlab, ...