NONLINEAR CONTROL THEORY
Homework #8 → for sunday 14 June 2020 @ 8pm

(a bonus may be granted for those who deliver their paper today 10 june at 12 noon)

You are invited to join the room
https://ec-nantes.zoom.us/j/98750253115 (password: 750091)
so that some technical tests can be completed.
Get your student card ready to display.

The standard TEAMS room will be open as well (in case of any last minute information).

1. **Consider the one-form** $\omega = (1+2x_1+x_2)dx1 + x_1dx_2$. Is it exact ? If yes, compute $\alpha(x_1, x_2)$ such that $\omega = d\alpha(x_1, x_2)$.

2. **Consider the one-form** $\omega = x_1dx_2 + x_2dx_3 + x_3dx_4$. Is it integrable ?

Compute $d\omega \wedge d\omega \wedge \omega$.
Do there exist two functions φ_1 and φ_2 such that $\omega \in span\{d\varphi_1, d\varphi_2\}$?
If yes, compute φ_1 and φ_2 .

3. **The nonholonomic integrator**

Check the accessibility of the following nonholonomic integrator:

$$\dot{x}_1 = u_1$$
$$\dot{x}_2 = u_2$$
$$\dot{x}_3 = x_1u_2 - x_2u_1$$

Is it fully (means input-state) linearizable by static state feedback ?

Is it fully linearizable by dynamic state feedback ? → **Hint: try to find 2 output functions with relative degree 1 and such that the decoupling matrix has rank 1 only !**