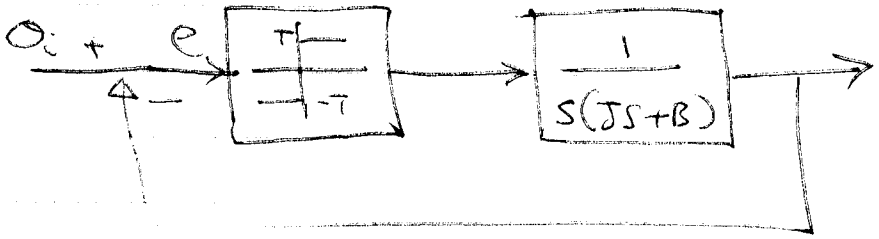
ECE436/ECE698 Ex 2

1) Sketch the phase plane for

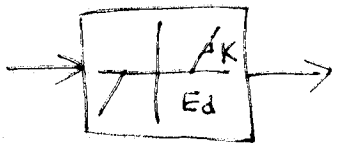


, $\theta_i = A$ constant

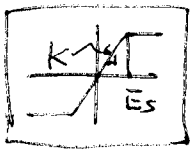
Verify your answers using pplane7 and Nelisys with $T = J = B = 1$, $A = 1$

2) Repeat 1) with $\theta_i = At$, a ramp
Verify again your answers using pplane 7 with $A = 1$.

3) Repeat 1) with the nonlinear element being



4) Repeat 1) with the nonlinear element being



slope = K

5] Given the following equations

a) $\dot{x}_1 = x_2 - x_1\left(x_1^2 + x_2^2 - 1\right)$
$\dot{x}_2 = -x_1 - x_2\left(x_1^2 + x_2^2 - 1\right)$

b) $\dot{x}_1 = x_2 + x_1\left(x_1^2 + x_2^2 - 1\right)$
$\dot{x}_2 = -x_1 + x_2\left(x_1^2 + x_2^2 - 1\right)$

Let $r = \sqrt{x_1^2 + x_2^2}$, $\theta = \tan^{-1}\frac{x_2}{x_1}$

Determine if a, ,b, exhibits limit cycle { stable, unstable, semi-stable

5) Given $\dot{x}_1 = x_2 + x_1 x_2^2$
$\dot{x}_2 = -x_1 + x_1^2 x_2$

Use Bendixson's theorem to determine if a limit cycle exists

7) Use Index theorem to show that the Van der Pol equation

$$\ddot{x} - \mu(1 - x^2)\dot{x} + x = 0$$

has a limit cycle around the origin (see lecture notes : limit cycle not contained by $|x| < 1$).
use pplane 7 to plot phase plane for $\mu = 1, 2, 5, 10, 20$