

**Homework 1**

**Name:**

1. Consider the following nonlinear system:

$$\dot{x}_1 = f_1(x_1, x_2, x_3) + g_1(x_1)u$$

$$\dot{x}_2 = f_2(x_1, x_2, x_3)$$

$$\dot{x}_3 = f_3(x_1, x_2, x_3)$$

$$y = h(x_3)$$

where  $x_1 \in \mathbb{R}$ ,  $x_2 \in \mathbb{R}$ ,  $x_3 \in \mathbb{R}$ ,  $u \in \mathbb{R}$ ,  $y \in \mathbb{R}$ ,  $f_1(0,0,0) = f_2(0,0,0) = f_3(0,0,0) = 0$  and  $g_1(0) \neq 0$ . Determine the relative degree of the controlled output  $y$  with respect to the manipulated input  $u$ , design an input/output feedback linearizing controller to stabilize the input/output dynamics and state under what conditions on the zero dynamics of the above system this controller enforces local asymptotic stability of the origin. Assume that the relative degree is well-defined in a neighborhood of the origin.