1. For the system described, y has a degree of 3 compared to the output u, because the first derivative of y involved only a partial derivative of $h(x_3)$, and also $f_3(x_1,\ x_2,\ x_3)$. The second rule contains partial derivatives of $f_3(x_1,\ x_2,\ x_3)$, which may include u, depending on f_3, because of the first derivative of x_1 (which contains $g_1(x_1)u)$. In this second derivative of y, u only appears inside other functions, not explicitly. So, the third derivative of y, which contains the second derivative of x_1, where both u and the first derivative of u appear, determines the degree above.

2. To get our input/output feedback linearizing controller, we need to use the output y differentiated 3 times, as explained above:

$$y^{(3)} = L_f^{\ 3}h(x) + L_g L_f^{\ 2}h(x)\cdot u$$

So, our control law for u can be defined as:

$$u = \frac{1}{L_g L_f^{\ 2}h(x)}(-\ L_f^{\ 3}h(x) + v)$$

(assuming $L_g L_f^{\ 2}\ h(x) \neq 0$ around the origin)

To control the output dynamics, we choose a v so that:

$$y^{(3)} = v$$

Which would take the form of something like (I'm just expressing in terms of y instead of introducing a z coordinate system):

$$v =-\ \delta_1 y\ \ -\delta_2 \dot{y}\ \ -\delta_3 \ddot{y}$$

For the zero dynamics, since $y = h(x_3)$, we know that as $x_3\ \rightarrow\ 0.\ y \rightarrow 0.$

So, the remaining states $x_1,\ x_2$ must stabilize on their own ($\dot{y} = \dot{x_3} = f_3(x_1, x_2, 0) = 0$

The controller stabilizes the origin locally asymptotically only if the dynamics of $x_1,\ x_2$ are locally asymptotically stable.