AMES 207
NONLINEAR CONTROL — Prof. M. Krstic

Homework 3

Due May 12, 1998

1. Khalil, Exercise 12.5.
   Hint: Start with $T_1(x) = x_1$ and apply the procedure (12.13), (12.14).

2. Khalil, Exercise 12.8.
   Hint: Apply Theorem 12.1. For inverse dynamics, use $\eta_1 = x_1$ and $\eta_2 = x_2 - x_3$.

3. Khalil, Exercise 12.31, Part (1).
   Hint: For involutivity, employ the result of Exercise 12.27.

4. Consider the nonlinear system

$$
\begin{aligned}
\dot{x}_1 &= x_2 + x_1 x_2 - x_2^2 + u \\
\dot{x}_2 &= x_1 x_2 - x_2^2 + u \\
\dot{x}_3 &= x_1 + x_1 x_2 - x_2^2 - (x_3 - x_1)^3 + u \\
y &= x_1 - x_2 \,.
\end{aligned}
$$

   (a) Show that the system has relative degree two.

   (b) Transform the system into the normal form. Hint: For the zero dynamics use $\eta = x_1 - x_3$.

   (c) Show that the origin of the zero dynamics is globally asymptotically stable.

   (d) Design a feedback law that achieves global asymptotic stability.