## Differential Equations Seminar: Week 11 Exercises

1. Use a Lyapunov function to determine the stability of the origin for the system

$$
\begin{aligned}
& x^{\prime}=-x-5 y \\
& y^{\prime}=3 x-y^{3}
\end{aligned}
$$

2. Use a Lyapunov function to determine the stability of the origin for the system

$$
\begin{aligned}
x^{\prime} & =-x-y^{3} \\
y^{\prime} & =x-y
\end{aligned}
$$

3. Use a Lyapunov function to determine the stability of the origin for the system

$$
\begin{aligned}
& x^{\prime}=-x-y^{2} \\
& y^{\prime}=-\frac{1}{2} y+2 x y
\end{aligned}
$$

4. Use a Lyapunov function to determine the stability of the origin for the system

$$
\begin{aligned}
& x^{\prime}=y \\
& y^{\prime}=-4 x-c y
\end{aligned}
$$

where $c>0$.

