EECE4130/16.413 Problem Set #4

1. The impulse response of is shown in the figure

If the system is modeled by the transfer function

\[ G(s) = \frac{A}{s^2 + 2\zeta \omega_n s + \omega_n^2} \]

a. Determine the damping factor \( \zeta \), natural frequency \( \omega_n \) and damped natural frequency \( \omega_d \)
2. Consider the system given in (a) is marginally stable.

The stabilized system is given in (b). If $K/J = 4$ what value of $K_h$ will yield the damping factor $\zeta = 0.6$. 

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3. Consider the SISO system where the input is $u$ and output is $y(t)$.

$$
\begin{bmatrix}
\dot{x}_1 \\
\dot{x}_2
\end{bmatrix} =
\begin{bmatrix}
-1 & -0.5 \\
1 & 0
\end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0.5 \\ 0 \end{bmatrix} u(t)
$$

$$
y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}
$$

a. Determined the impulse response of the system.
b. Determined the unit step response of the system.