Test of Prerequisites

1. Consider the differential equation
$$\dot{y} = -3y + u.$$
Use Laplace transformation to setup a transfer function from u to y, when assuming $y(0) = 0$.

2. Consider the transfer function
$$H(s) = \frac{s+1}{(s+2)(s+3)}.$$
   - Where are the poles of the transfer function $H(s)$ located?
   - Where are the zeros of the transfer function $H(s)$ located?
   - What is the DC-gain of $H(s)$?
   - Is $H(s)$ stable?

3. Consider the difference equation
$$y_{k+1} = \frac{1}{2}y_k + u_k$$
where $k \in \mathbb{N}$ denotes the sample number. Use z-transformation to setup a discrete transfer function from u to y.

4. Is $\begin{bmatrix}1\\2\end{bmatrix}$ an eigenvector of $\begin{bmatrix}2 & 2\\0 & 3\end{bmatrix}$?

5. What is the rank of $\begin{bmatrix}1 & 2\\2 & 4\end{bmatrix}$?

6. What are the eigenvalues of $\begin{bmatrix}-1 & 0\\0 & 4\end{bmatrix}$?

7. Consider the differential equation
$$\dot{y} = -3y.$$
Write an expression of the solution to the differential equation for $y(0) = y_0$.