Test of Linear Time-Invariant Systems

1. Consider the differential equation
$$\ddot{z} - 2\dot{z} = -3z + u$$
   and assume that $\dot{z}$ is the output.

   - Write the system on state space form.

   - Write a transfer function that describes the input-output behavior of the system.

2. Consider the transfer function
$$H(s) = \frac{y(s)}{u(s)} = \frac{1}{(s+2)(s+3)}.$$
   Transform the system into state space form.

3. Laplace transform the state space model
$$\dot{x} = Ax + Bu$$
$$y = Cx$$
   and provide the transfer function between input u and output y.

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