1) What are three uses of Modal Decomposition?
Decoupling LTI systems, Stability analysis, Modal analysis, Model Reduction, System Design

2) Consider the following state matrix:
\[
\begin{bmatrix}
1 & 0 & 1 & 0 & -6 \\
0 & 2 & 2 & 1 & 0 \\
1 & 2 & 3 & 0 & 0 \\
0 & 1 & 0 & 2 & 0 \\
-6 & 0 & 0 & 0 & 1 \\
\end{bmatrix}
\]
How many imaginary eigenvalues does it have? 0
How many distinct eigenvalues does it have? 5
Can it be diagonalized? yes
How many linearly independent eigenvectors can be associated with its eigenvalues? 5

3) Are the following systems stable? Why?
\[
G(s) = \frac{s}{s^3 + 4s^2 + 5s + 2} = \frac{s}{(s+1)(s+1)(s+2)}, \text{ STABLE, all roots have negative real parts}
\]
\[
G(s) = \frac{2s+1}{s^3 + 4s^2 + 5s + 2}, \text{ STABLE, same denominator as above.}
\]
\[
G(s) = \frac{2s+1}{s^3 + 2s^2 - s - 2} = \frac{2s+1}{(s-1)(s+1)(s+2)}, \text{ UNSTABLE, one root has a positive real value.}
\]

4) Marginally Stable