Explaining Gain Margin and Phase Margin

Suppose we have a system that has been modeled as the transfer function $G(s) = \frac{2}{s(s^2+2s+2)}$ and we want to know some additional information about the system. First, we will generate a Bode plot by setting up an open-loop system shown below. Our input is a sine wave with a particular amplitude (X) and frequency (ω). The output will also be a sine wave and it will have the same frequency as the input sine wave but with a phase shift (ϕ). The output sine wave amplitude (Y) will not necessarily be the same as the input sine wave amplitude.

$$x(t) = Xsin(\omega t) \rightarrow \boxed{\frac{2}{s^3+2s^2+2s}} \rightarrow y(t) = Ysin(\omega t + \phi)$$

By looking at the Bode plot, we can learn about the stability of the system if we were to close the loop.