5.

a) $\cancel{\quad} K_f I_c - bxs - k_1 x = mxs^2$

$$F = K_f I_c = mxs^2 + bxs + k_1 x$$

$$\frac{X}{F} = \frac{1}{ms^2 + bs + k_1} = \frac{w_n^2}{s^2 + 2\zeta w_n s + w_n^2}$$

Resonant Freq seems to lead to a 20dB jump.

so $20 = 20 \log (M)$

$M = 10$

to get ζ, $M = \dfrac{1}{2\zeta\sqrt{1-\zeta^2}}$

so, $\zeta = 0.05$

From the given Bode plot, w_n is at $w_n = 10^3$

Then, we can solve for m_1, b_1, and k_1.

$$\boxed{\begin{aligned} m_1 &= \tfrac{1}{100} \\ b_1 &= 1 \\ k_1 &= 10^4 \end{aligned}}$$

b) From part a), we can see that

$$G_p(s) = \frac{1}{10^4} \cdot \frac{10^6}{s^2 + 100s + 10^6} = \boxed{\frac{100}{s^2 + 100s + 10^6}}$$

with the time delay accounted for,

$$\boxed{G_p(s) = \frac{100 \cdot e^{-1.2\times10^{-5} s}}{s^2 + 100s + 10^6}}$$