

SFWR ENG 3DX4 – Assignment 4

1. A robot arm has a joint-control open-loop transfer function

$$G(s) = \frac{300(s + 100)}{s(s + 10)(s + 40)}$$

- (a) Plot the asymptotic approximation of the Bode plot.
 - (b) Repeat (a) with the pole at 0 in the denominator replaced by a pole at -1.
 - (c) For the system in (b), estimate the bandwidth using only the asymptotic approximation (as discussed in lecture).
 - (d) Use MATLAB to find the bandwidth of the system in (b). Why is the result different than your answer in (c)?
2. A system has plant

$$G(s) = \frac{3s^2 + 4s - 2}{s^3 + 3s^2 + 7s + 5}$$

Add state variable feedback so that the closed-loop poles are at -4, -4 and -5.

3. A system is given by

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 9.8 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 0 \\ -1 \end{bmatrix} u$$

Use state variable feedback to place the closed-loop poles at $s = -2 \pm j$, -5, and -5.