System Dynamics Final Exam

November 28, 2023

First Last

[1]:
```
import control as ct
import numpy as np
import matplotlib.pyplot as plt
import sympy as sp
from scipy.optimize import fsolve

# Use whichever pertains to your set-up
# plt.style.use('maroon_ipynb.mplstyle')
# plt.style.use('../maroon_ipynb.mplstyle')
```

Contents

1 Problem 1

1.1 Given

$$T(s) = \frac{X(s)}{Y(s)} = \frac{10}{10s^2 + 15s + 17}$$

1.2 Find

For the transfer function above,

a. Plot the magnitude ($M(\omega)$ not in decibels) and phase response for $0.1 \leq \omega < 10\, rad/s$. You can use whichever method you prefer, but only use the `bode()` function for checking.
b. Find the resonant frequency ω_r.
c. If the input function is $y(t) = 11\sin(5t)$, find the steady state function $x_{ss}(t)$. Plot the result with the transient response up to 6 seconds.

1.3 Solution

1.3.1 Part A - Plotting the Frequency Response (20 Points)

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1.3.2 Part B - Finding the Resonant Frequency (10 Points)

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1.3.3 Part C - Getting the Transient and Steady State Response (20 Points)

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2 Problem 2

2.1 Given

$$T(s) = \frac{1}{30s^2 + 30s + 40}$$

2.2 Find

For the transfer function above,

a. Find the analytical solution for the magnitude response ($M(\omega)$).
b. Plot the magnitude response from $0.1 \leq \omega < 10\, rad/s$.
c. Find the bandwidth (ω_1 to ω_2) and classify the filter type.

2.3 Solution

2.3.1 Part A - Finding the Magnitude Response Analytically (15 Points)

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2.3.2 Part B - Plotting the Magnitude Response (15 Points)

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2.3.3 Part C - Finding the Bandwidth (20 Points)

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