Vibrations and Controls Homework 8

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```python
# Notebook Preamble
%config ZMQInteractiveShell.ast_node_interactivity = 'all'
import sympy as sp
import numpy as np
import matplotlib.pyplot as plt

plt.style.use('maroon_ipynb.mplstyle')
```

Contents

1 Problem 10.7

1.1 Given

$$\theta$$

Shaft 2:
inertia I_2 3:1 θ Shaft 3:
inertia I_3

θ_2

2:1

Shaft 1:
inertia I_1 θ_1

Feedback
pot

Motor

$$\theta_2 = \frac{1}{2}\theta_1$$
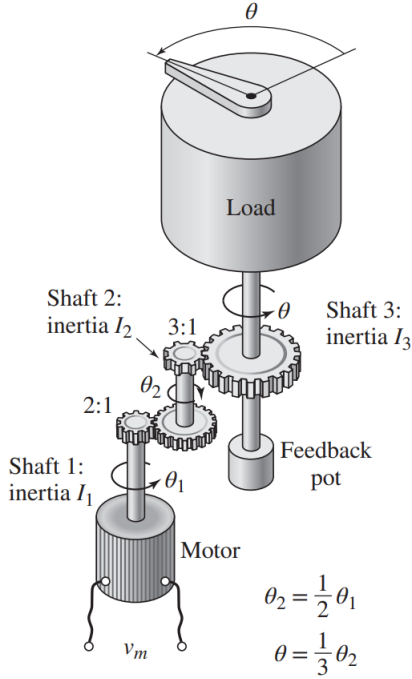
v_m

$$\theta = \frac{1}{3}\theta_2$$

Figure 1

Figure 1 shows a system for controlling the angular position of a load, such as an antenna. There is no disturbance.
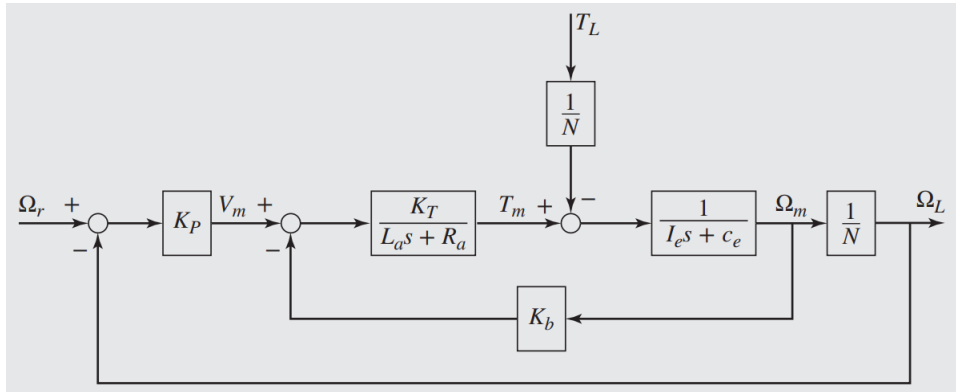
1.2 Find

Figure 2

a. Draw the block diagram of a system using proportional control, similar to that shown in Figure 2 except that the command and the output are angular positions. Assume that the motor is armature-controlled and that its armature time constant is negligible. Let the inertia

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I_e be the equivalent inertia of the entire system, as felt on the motor shaft, and let N_e be the equivalent gear ratio of the entire system, as felt on the motor shaft. Show the necessary transfer functions for each block.

b. Determine the value for N_e, and determine I_e as a function of the inertias I_1, I_2, and I_3.