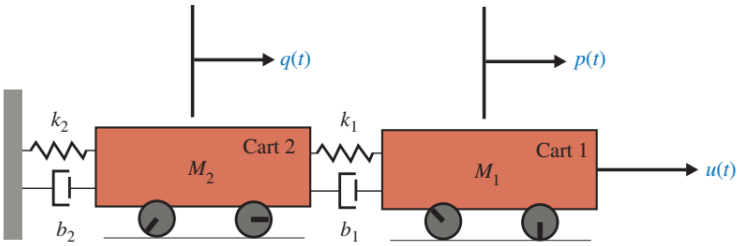
MAK 440 Design of Control Systems

Homework # 1

Due: 3/5/2024 12:00am

1) Consider the mechanical system below: two rolling carts. (5 pts).



a) Develop the state space model manually. Clearly show your derivations.

b) Suppose that the two rolling carts have the following parameter values: $k_1 = 150$ N/m; $k_2 = 700$ N/m; $b_1 = 15$ N s/m; $b_2 = 30$ N s/m; $M_1 = 5$ kg; and $M_2 = 20$ kg. create the response of the system with the initial conditions, $p(0) = 0.1$ m, $q(0) = 0$, and $\dot{p}(0) = \dot{q}(0) = 0$ and there is no input driving force, that is, $u(t) = 0$. (hint use MATLAB with lsim command). Provide MATLAB codes with output graphs.

2) Consider the following system. (5 pts).

$$\frac{Y(s)}{R(s)} = T(s) = \frac{14(s+4)}{s^3 + 10s^2 + 31s + 16}.$$

a) Obtain a state-space representation manually.
b) Code the state-space system in MATLAB, and obtain step response. Also provide pole-zero map as well. Provide MATLAB codes with output graphs.