Assignment #1 : System Modeling, Feedback, and Root Locus Design

Electronic Control Systems

Dept. of Electronic and Telecommunication Engineering, University of Moratuwa

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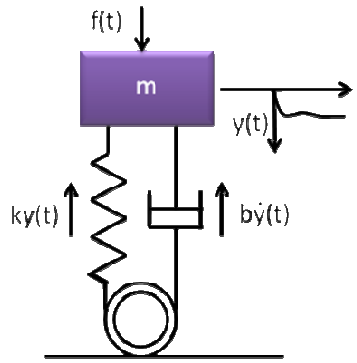
Q1 A motor cycle shock-absorber is shown below



where k and b are spring constant and daming coefficient. Draw the free-body diagram and derive the ordinary differential equation of the shock-absorber dynamic model

1. Derive the transfer function G(s)=Y(s)/F(s) of the shock-absorber, where Y(s) and F(s) are the Laplace transforms of response y(t) and external force f(t).
2. Determine the characteristic equation of the shock-absorber for k=175N/cm, b=600Ns/cm, and m=75kg, and determine the poles of the shock-absorber model.

Q2 A plant transfer function is $(s+6)/(s+1)(s+2)$

1. Calculate the DC gain of the open loop plant. Sketch the unit step response and comment on the nature of the response.
2. Introduce a feedback gain K and derive the closed loop transfer function. Draw the root locus of the closed loop system. Read from the root locus the values of K for which the response is (a). critically damped, and (b) most oscillatory.
3. Sketch the critically damped and most oscillatory unit step responses and comment on the nature of those responses. Could you practically use these controllers for mechatronic control systems? Justify your answer.

[*Note: The answer script should contain your manual work, m-codes, and MatLab figures*]