

MCE 403/503: Modeling and Simulation of Mechatronic Systems
Homework 5 - Fall 2010

OUT: 11-24-10. DUE: 12-10-10 by 5PM. No homework will be accepted past the due date and time.

1. (50 pts) Solve the following problems from KMR, 4th Ed.:

1. 7-1 (MCE403 and MCE503)
2. 7-6 (MCE403 only)
3. 7-13 (MCE503 only)

2. (50 pts) Figure 1 shows a cantilever beam of length 300 mm, Young's modulus 210 GPa and density 7850 kg/m³. The beam has a cross section of 6mm by 1mm, with the force applied parallel to the short side. A spring-damper assembly is attached to the end, with $k=100$ N/mm and $b=0.2$ N-s/m. A moment input is applied at a distance $d_1=200$ mm, while the force is applied at $d_2=150$ mm.

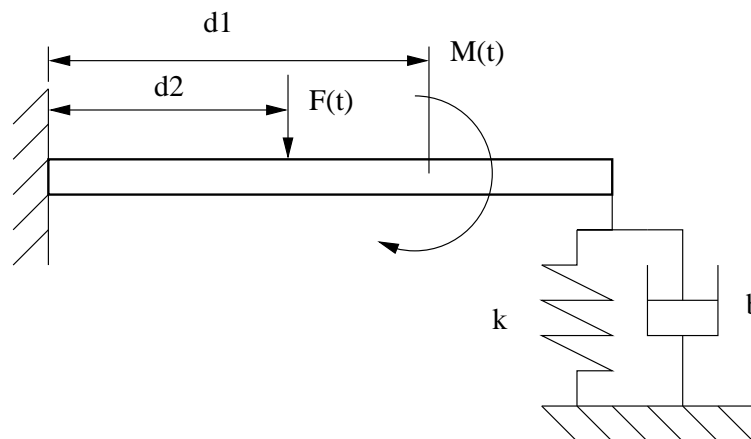


Figure 1: Problem 2

Do the following:

1. MCE403 only: Derive a 3-mode bond graph model for the system. Calculate the values of every transformer, capacitor, inertia and resistance in the system. Assign causality and predict the number of state equations.
2. MCE503 only: The same as above, but include the necessary elements so that the velocity of a point located at 100mm from the root is explicit in the bond graph.
3. Give the values of the first three frequencies in Hertz.

Document your work in a neat and very organized way.