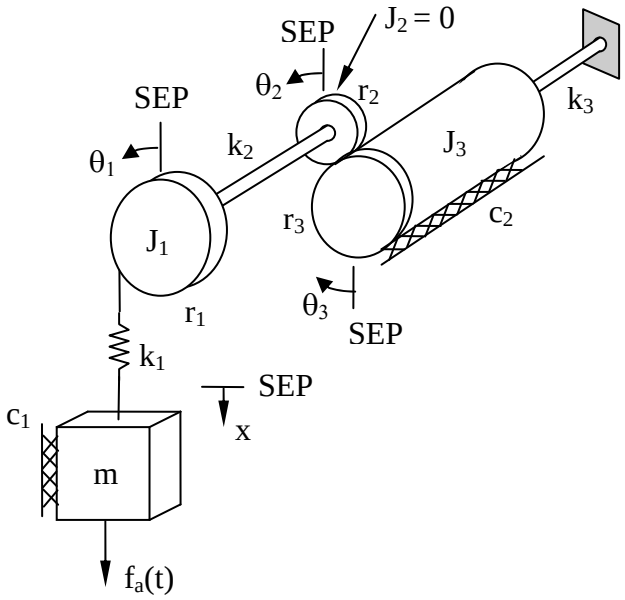
Homework Lecture 4
ES205

Problem 4.1
For the system shown below, the input is force $f_a(t)$ and the output variables are x, θ_1, and θ_3. Write the three differential equations of motion for the system in standard second order form.

Hint: To reduce your equations to just three eliminate the contact force between disks 2 and 3. Solve for F in the equation obtained from looking at disk 2 and substitute into the equation found from looking at disk 3. To eliminate θ_2 use kinematics to relate θ_2 and θ_3.



Problem 4.2 Consider the torsional system shown in below. Assume that the system is constrained to rotate about its fixed longitudinal axis. The mass moments of inertia of disks 1 and 2 are J_1 and J_2 as shown. The torsional stiffnesses are K_1 and K_2, and the torsional damper is C.
(a) draw the necessary free-body diagrams
(b) derive the differential equations
(c) determine the four transfer functions: Θ_1/T_1, Θ_1/T_2, Θ_2/T_1, Θ_2/T_2
(d) determine the state space representation when the outputs are considered the displacements θ_1 and θ_2.