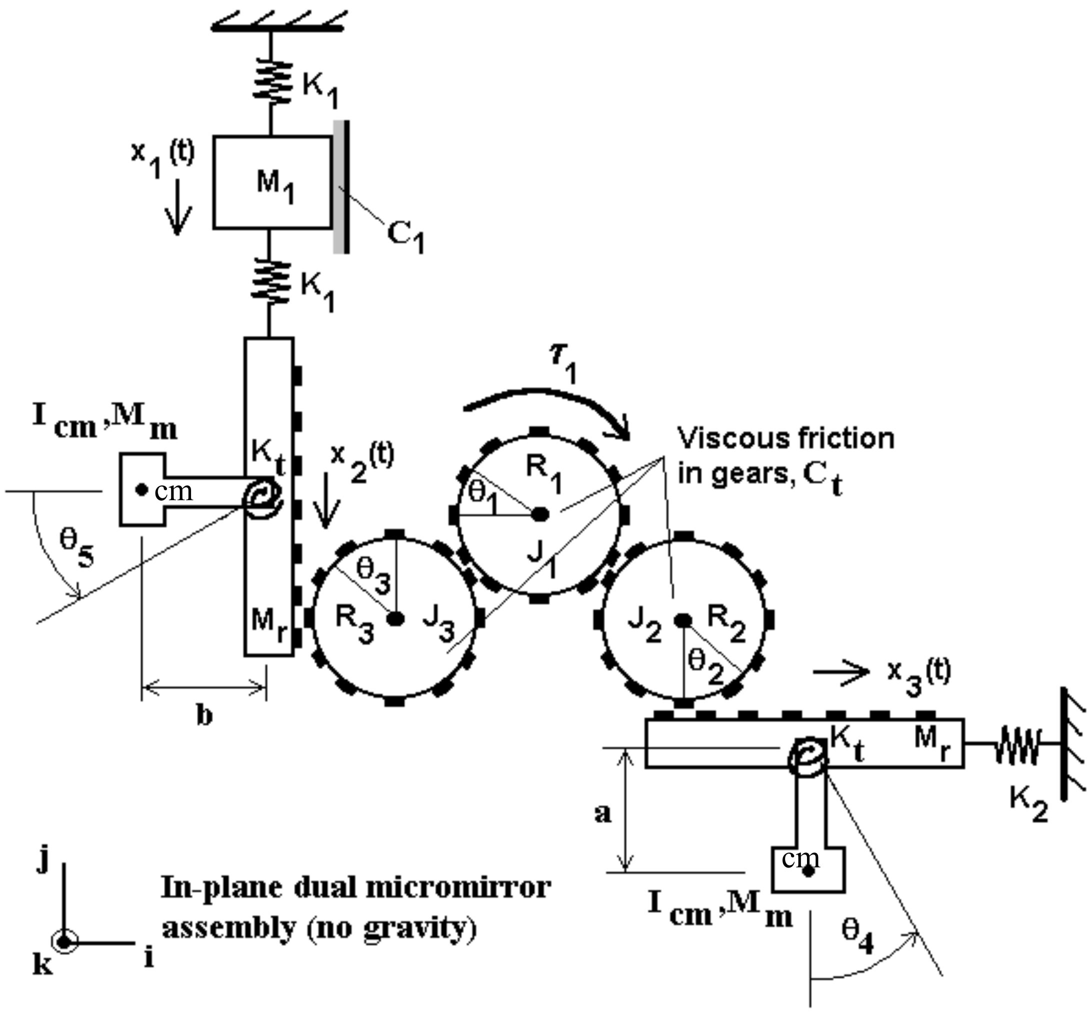
ME 563 **HOMEWORK # 2** **Fall 2010**

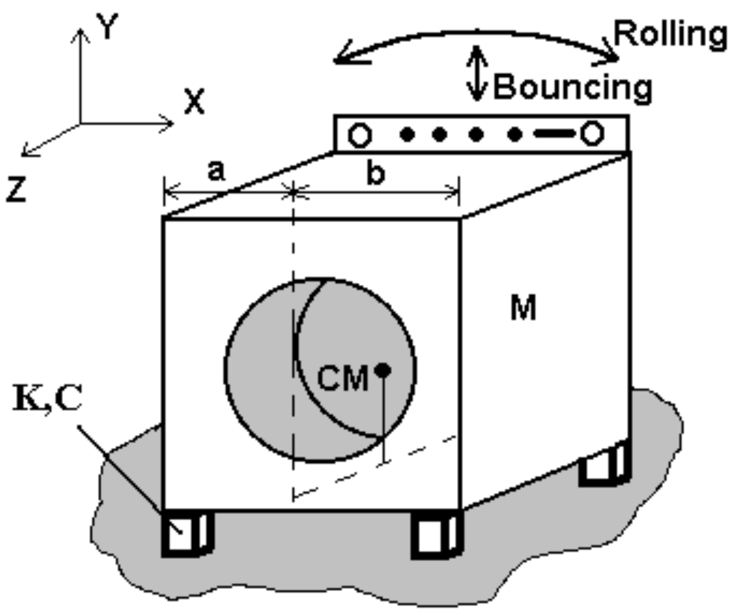
PROBLEM 1: (40%)

Derive the equations of motion for the dual micromirror system shown below using both Newton-Euler techniques and Lagrange's equations. Assume that the two racks, M_r, experience only translational motion. The two mirrors, I_{cm}, are free to swing about the pins that connect them to the two racks. Give all relevant information you need to solve the problem using the procedure developed in class. Note that the "cm" points on the two swinging pendulums are not fixed points.



PROBLEM 2: (30%)

A clothes dryer of mass, M, is shown below with four rubber supports, which have stiffness K and viscous damping coefficient C. The unbalance effect can be modeled with a forcing function, *f(t)*, that is applied vertically through the geometric center of the basket as it rotates. Develop a mechanical vibration model of this system to describe the bouncing and rolling motions of the dryer for relatively small roll rotations, θ, and derive the equation(s) of motion using Lagrange's equations. Assume that the dryer supports are always in contact with the ground. Describe the effects of changes in a and b as well as changes in K and C for different supports.



<u>PROBLEM 3</u> (30%)

A crane of mass, M, with mass moment of inertia, I_{cm}, is shown below moving a crate of mass, M_c. An applied torque, τ, at the base of the crane at point O positions the crane, which is a distance, r, away from the end of the crane. Assume that the cable has stiffness, K, which suggests that the cable can extend while remaining in tension at all times. Model the vibrations of the crane-crate system in the plane of the page and derive the equation(s) of motion using Lagrange's equations.