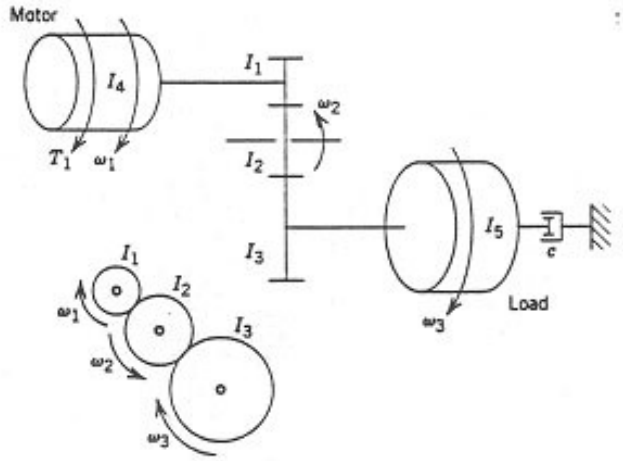
MEEN 2210 Electromechanical Engineering Systems Spring 2011

Problem Set #6 Due March 30, 2011

1. A load inertia I_5 is driven through a double-gear pair by a motor with inertia I_4, as shown. The shaft inertias are negligible. The gear inertias are I_1, I_2, and I_3. The speed ratios are $\omega_1/\omega_2 = 2$ and $\omega_2/\omega_3 = 5$. The motor torque is T_1 and the viscous damping coefficient is c. Neglect elasticity in the system. Derive the mathematical model for the motor shaft speed ω_1 with T_1 as the input.



2. The robot arm shown has six joints. We will model one of those joints with the ultimate goal to design a position controller to ensure that the angle θ of the robot arm joint tracks a prescribed profile. The joint is actuated by a dc motor (not modeled in this exercise) that drives an arm, mass m and mass moment of inertia about its mass center I_{arm}, through a gear pair. The mass center of the arm is located a distance L from the rotational axis of the joint. The motor and gear axes are fixed by bearings. Derive the equation of motion between the input motor torque T_m and the angular position of the arm θ. Neglect any compliance in the system.