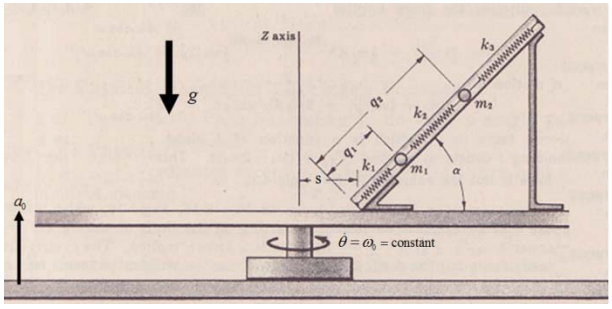
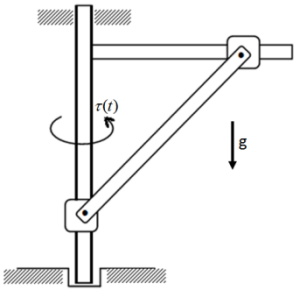
Advanced Dynamics - Assignment #2

Problem 1 (Two Particle-Spring Assembly): An assembly of two particles and springs in a cylinder mounted on a turntable which rotated at a constant angular speed on an elevator whose acceleration is constant a_0 in the upward direction. The free length of the spring i is l_i while its spring constant is k_i. Using virtual work principle, obtain the equilibrium configuration.

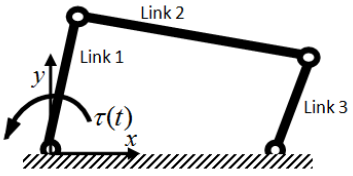


Problem 2: Using extended d'Alembert's principle derive the equations of motion for the previous system.

Problem 3 (Two-Sliding Collar System): In the two-sliding collar system shown, the rigid inverted Γ shaped frame is rotating due to actuating torque $\tau(t)$. The collars are identical and are considered to be point mass with mass *m*. The connecting rod is uniform and has mass *M* and length *l*. Using Lagrange's equations derive the equations of motion. Is there any equilibrium configuration? Can you derive it from equations of motion?



Problem 4 (Four bar Linkage): A planar four bar linkage is shown in the following figure. The mechanism moves in the vertical plane due to actuating torque $\tau(t)$. Links are all uniform and have different masses and lengths. Using Lagrange's equations and considering the rotation angle of the links (with respect to the horizontal line – *x* axis) as the generalized coordinates, derive equation of motion of the system in the reduced form,



Problem 5 (Two Wheeled Inverted Pendulum): Wheels are identical and have mass *m* and moment of inertia I_w. The T shape frame has mass *M* and I_x, I_y, I_z about its principle axes $x_f y_f z_f$. The system motion is due to the driving motors of the wheels. Derive the equations of motion in the reduced form, using Gibbs-Appell's equations as well as Kane's equations.