Department of Mechanical Engineering
Indian Institute of Technology Madras

ME 5233 Multi-body Dynamics & Applications

Assignment 2

Due on: **September 30, 2023**

1. For the system shown in Fig. 1a, let $F = 10$ N, $M^2 = 3$ Nm, $M^3 = 3$ Nm, $\theta^2 = 45°$, and $\theta^3 = 30°$. Determine the generalized forces associated with the generalized coordinates θ^2 and θ^3. Include the effect of gravity in your calculations.

2. Use the principle of virtual work in dynamics to determine the joint torques M^2 and M^3 for the system shown in Fig. 1a. Use the following data: $\theta^2 = 45°$, $\theta^2 = 30°$, $\dot{\theta}^2 = 70$ rad/s ACW, $\dot{\theta}^3 = 40$ rad/s ACW, $\ddot{\theta}^2 = 120$ rad/s^2 ACW, $\ddot{\theta}^3 = 180$ rad/s^2 ACW, and $F = 10$ N. Assume that the two links shown in the figure are uniform slender rods. Consider the effect of gravity.

3. The system shown in Fig. 1b consists of a slider block of mass m^2 and a uniform slender rod of mass m^3, length l^3, and mass moment of inertia about its center of mass J^3. The slider block is connected to the ground by a spring that has a stiffness coefficient k. The slider block is subjected to the force $F(t)$, while the rod is subjected to the moment $M(t)$. Obtain the differential equations of motion of this two-degree-of-freedom system using Lagrange's equation.

Figures are from: A. A. Shabana, 2010, ***Computational Dynamics****, Third Edition, John Wiley & Sons.*

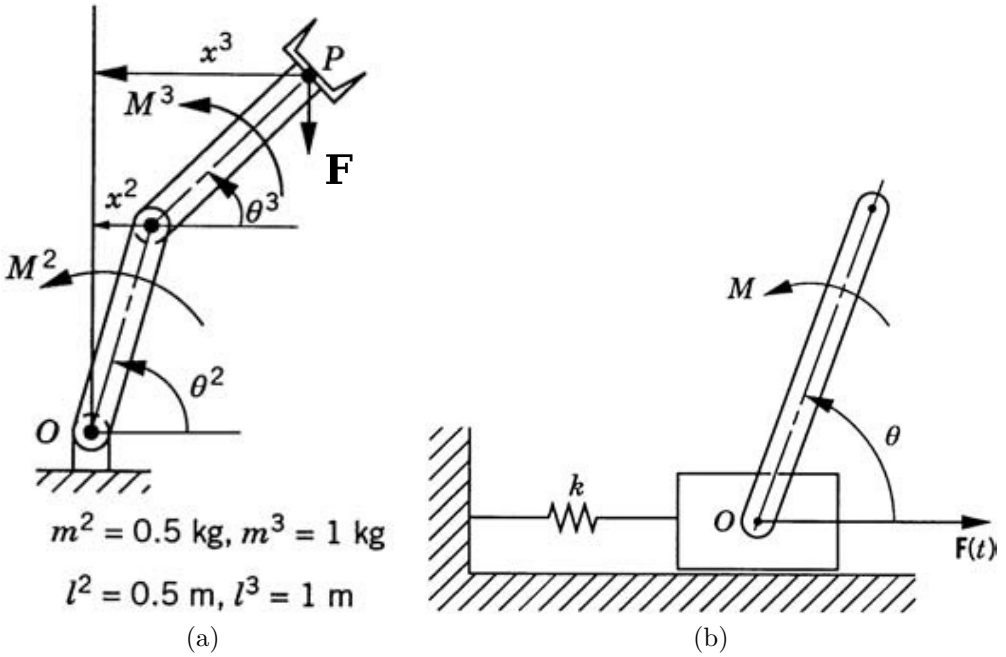

Figure 1: Figures for Problems.