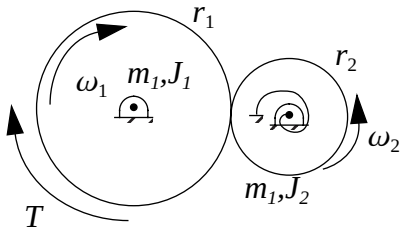
ME 499 Exam 1, Winter ‘97

1) Derive lumped equations of motion for the following rod. Use A =1 cm^2, ρ = 2700 kg/m, E = 7e10 Pa, and l = 10 cm. The maximum frequency of the driving force F_1 is 12,000 Hz.

2) Derive the equation/s of motion of the following gear system. A torque T is applied to the left gear, and a coil spring is attached to the right gear (Torsional stiffness k). Assume no slipping of the gears and that they each pivot about their center points.



3)Draw a block diagram of the following equation/s of motion using the given blocks.

$$m_1\ddot{x}_1 + c_1(\dot{x}_1 - \dot{x}_2) + k_1(x_1 - x_2) = F_1$$

$$m_2\ddot{x}_2 + c_2\dot{x}_2^3 + c_1(\dot{x}_2 - \dot{x}_1) + k_1(x_2 - x_1) = F_2$$