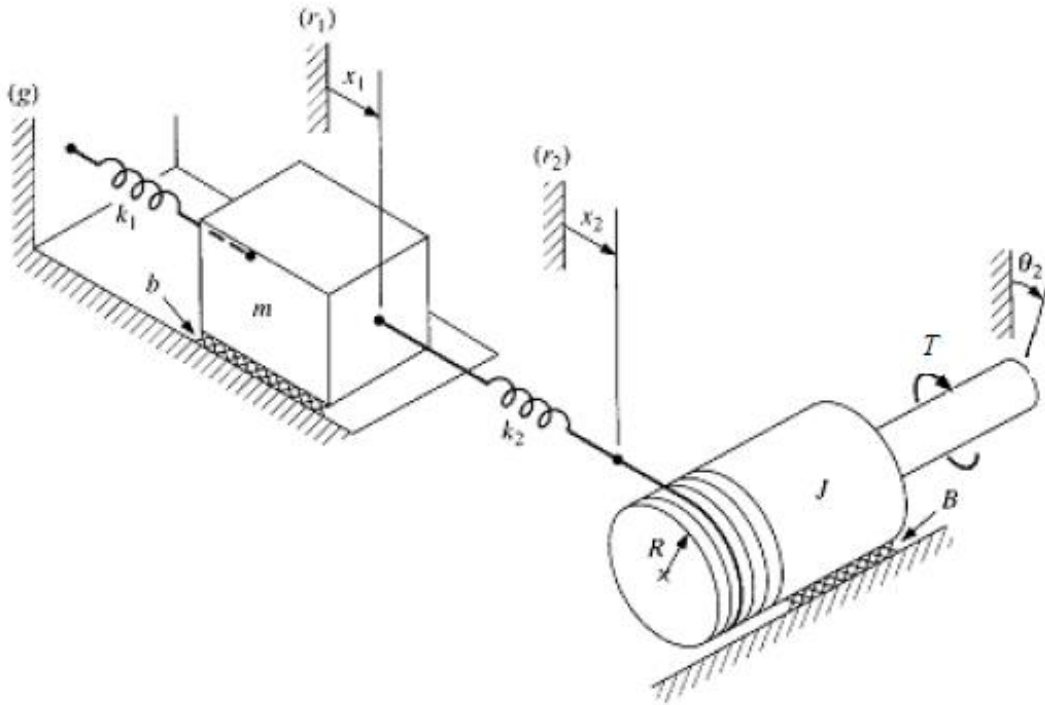


**MAK403 AUTOMATIC CONTROL
HOMEWORK 2
Dr. Nurdan Bilgin
Submit Date:07/11/2019-On the Lecture**

QUESTION



The figure shows a mechanical system with translational and rotational elements.

- Write the elemental and connectivity equations.
- Note that the input is torque T_m applied on the drum. Let X_1 and θ_2 be the outputs of interest. So, obtain the following transfer functions by using the Laplace transforms of equations written by yourselves.

$$G_{X_1 T}(s) = \frac{X_1(s)}{T(s)} = \frac{Rk_2}{Jms^4 + (Jb + mB)s^3 + (Jk_1 + Jk_2 + Bb + R^2mk_2)s^2 + (Bk_1 + Bk_2 + R^2k_2b)s + R^2k_1k_2}$$

$$G_{\theta_2 T}(s) = \frac{\theta_2(s)}{T(s)} = \frac{(k_1 + k_2) + bs + ms^2}{Jms^4 + (Jb + mB)s^3 + (Jk_1 + Jk_2 + Bb + R^2mk_2)s^2 + (Bk_1 + Bk_2 + R^2k_2b)s + R^2k_1k_2}$$

- Again, by using the Laplace transforms of the equations written by yourselves, draw a detailed block diagram of the system taking $X_1(s)$ as the output.
- Then, by using the block diagram manipulation rules, re-obtain the transfer function