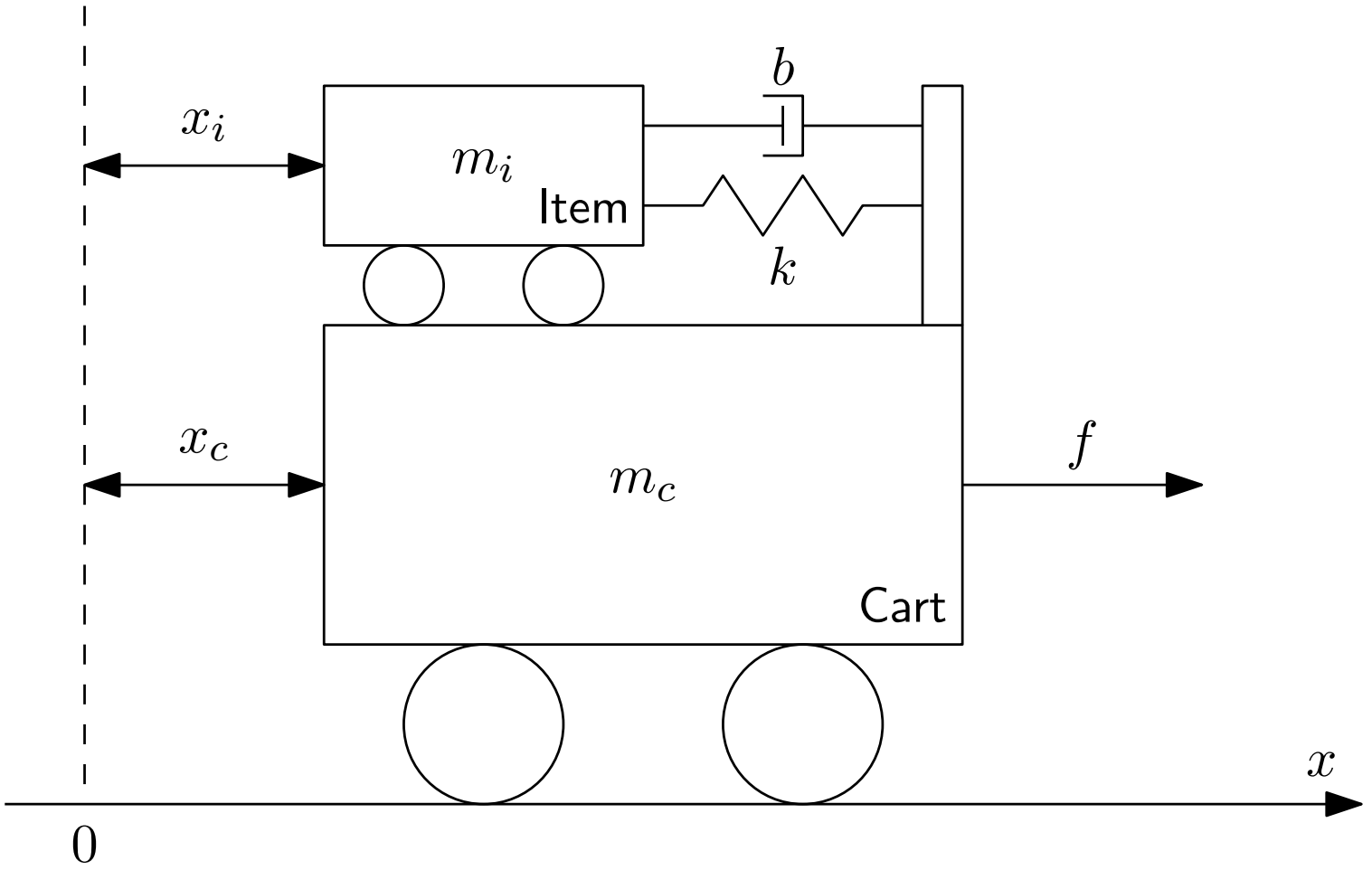
Introduction for Cart & Item Plant Model

Control Engineering 1

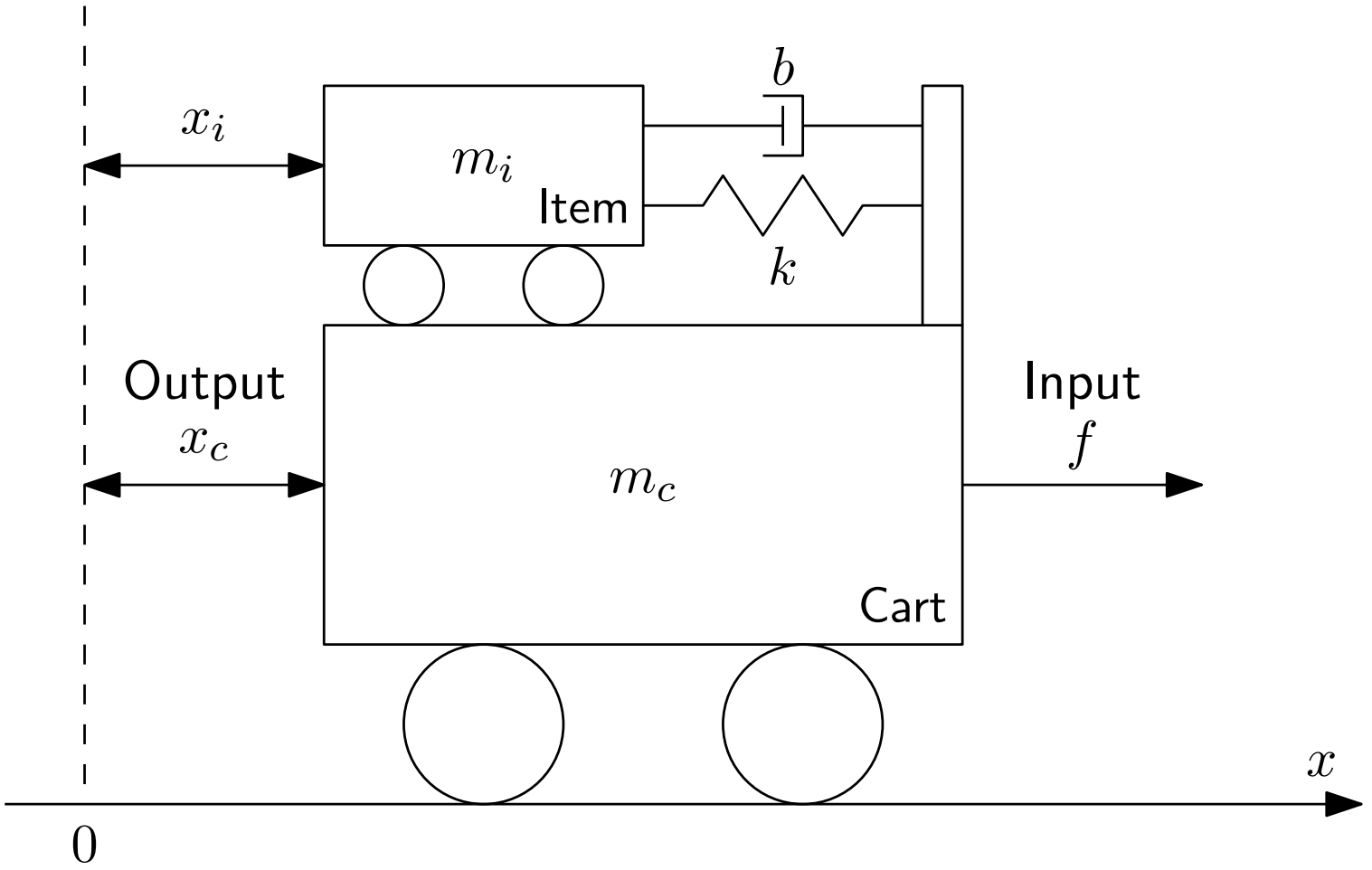
Motion Equations of Cart & Item Plant Model

$$m_i\ddot{x}_i = b(\dot{x}_c - \dot{x}_i) + k(x_c - x_i)$$
$$m_c\ddot{x}_c = f - b(\dot{x}_c - \dot{x}_i) - k(x_c - x_i)$$



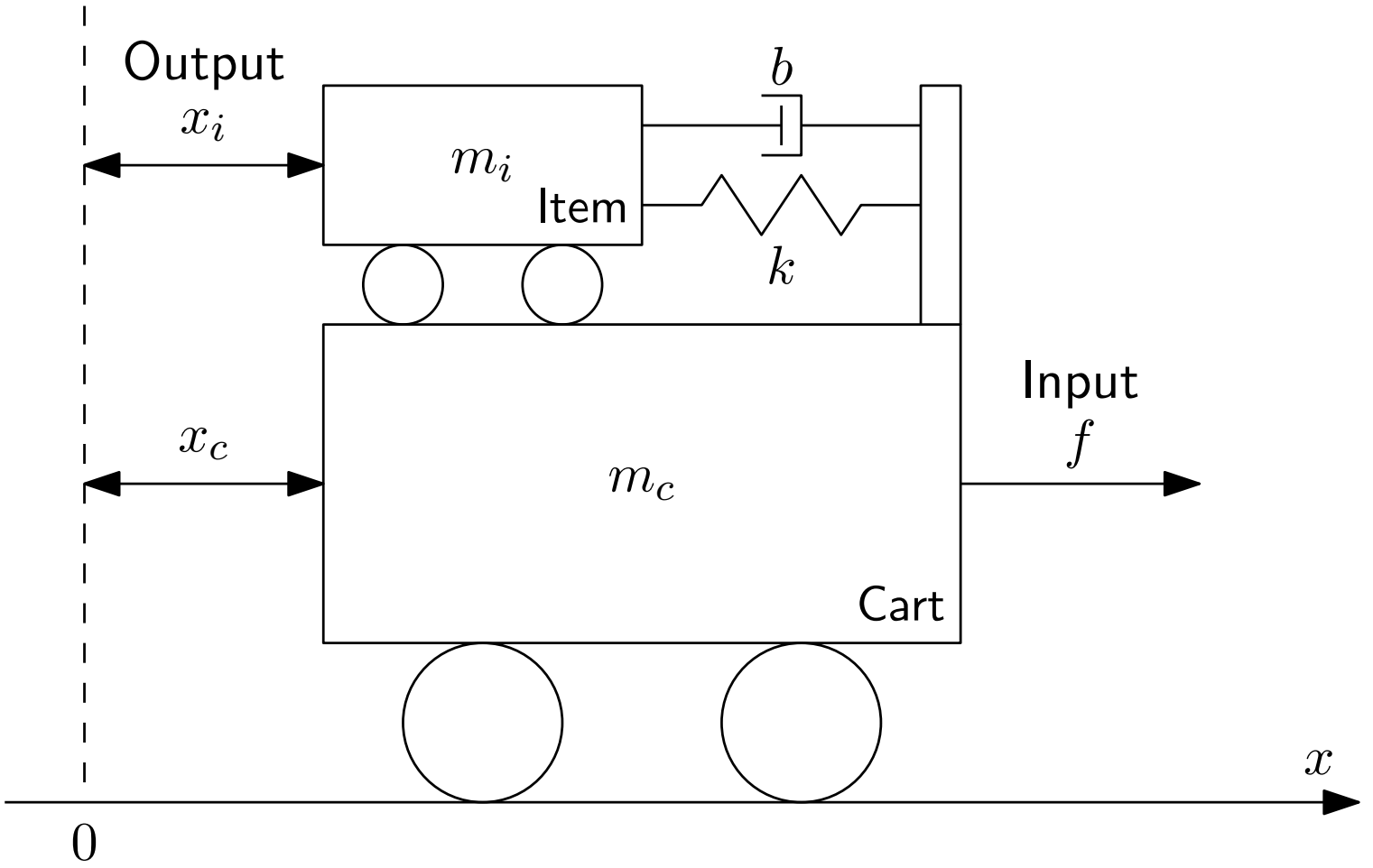
Transfer Function from f to x_c

$$P_{\text{cart}}(s) = \frac{X_c(s)}{F(s)} = \frac{m_i s^2 + bs + k}{m_c m_i s^4 + (m_c + m_i) b s^3 + (m_c + m_i) k s^2}$$



Transfer Function from f to x_i

$$P_{\text{item}}(s) = \frac{X_i(s)}{F(s)} = \frac{bs + k}{m_c m_i s^4 + (m_c + m_i) b s^3 + (m_c + m_i) k s^2}$$



Bode Diagram of $P_{\mathrm{cart}}(s)$ & $P_{\mathrm{item}}(s)$

$m_c = 1\,\mathrm{kg}, \quad m_i = 1\,\mathrm{kg}, \quad b = 10\,\mathrm{kg/s}, \quad k = 40\,000\,\mathrm{kg/s^2}$