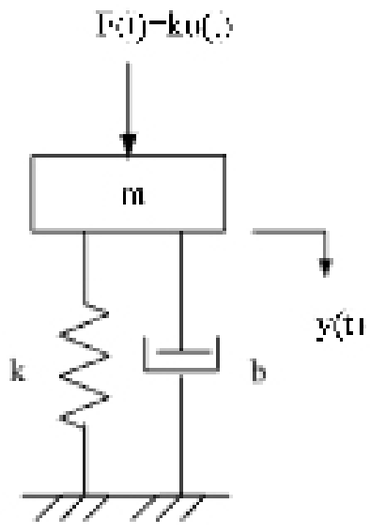
Second order system (mass-spring-damper system)

- ODE : $\ddot{y}(t) + \frac{b}{m}\dot{y}(t) + \frac{k}{m}y(t) = \frac{k}{m}u(t)$



ζ : dampling ratio, ω_n : natural frequency

$$2\zeta\omega_n = b/m,\ \omega_n^2 = k/m$$

$$\ddot{y}(t) + 2\zeta\omega_n\dot{y}(t) + \omega_n^2 y(t) = \omega_n^2 u(t)$$

- Transfer function :

$$\frac{Y(s)}{U(s)} = H(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n^2 s + \omega_n^2}$$