TASK

Derive the time discrete equation of the following two transfer functions to perform system identification

a) $G(s) = \dfrac{\theta(s)}{v_m(s)} = \dfrac{K}{s(\tau s + 1)}$

b) $G(s) = \dfrac{\theta(s)}{v_m(s)} = \dfrac{K}{s(s^2 + 2D\omega_0 s + \omega_0^2)}$

Use the following **hints**:

1. In the experiment your are provided with the angular velocity $\dot{\theta}(s)$ instead of $\theta(s)$, so the transfer function must be adapted.
2. The general structure of the system identification equation in discrete time is

$$y[n] = \sum_{k=1}^{\infty} a_k y[n-k] + \sum_{k=0}^{\infty} b_k u[n-k]$$

   e.g. the recent system output is on the left side *without* any factor, all other system outputs and all inputs are on the right and may have a factor in front.
3. Use the following two approximations for the time derivative

   i) $\dot{x}[n] = \dfrac{x[n+1] - x[n]}{T}$

   ii) $\ddot{x}[n] = \dfrac{x[n+2] + x[n] - 2x[n+1]}{T^2}$,

   where T is the sampling time.
4. You may assume that the system was at rest at the beginning, e.g. $\mathcal{L}(\dot{x}(t)) = s \cdot X(s)$