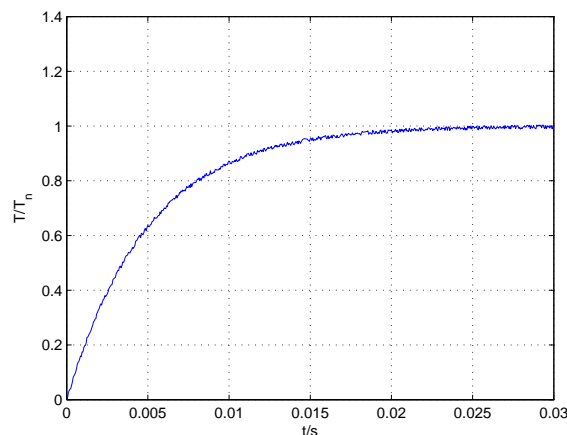


Exercise 10: DC Motor with 4-Quadrant-converter

Given is a permanent magnet DC machine operated by a four-quadrant converter. The following data are given:

- $U_N = 250 \text{ V}$
- $n_0 = 1000 \text{ min}^{-1}$
- $R_A = 0,2 \Omega$
- $I_n = 30 \text{ A}$
- $I_0 = 7 \text{ A}$
- $J = 0,5 \text{ kgm}^2$

The controller is operated at switching frequency $f_s = 8 \text{ kHz}$. If the rated voltage is switched sharply onto the motor at standstill, the step response results as shown in the following figure:



Questions:

a) Motor parameters

Calculate the following motor parameters:

- Permanent flux ψ'_E
- Armature inductance L_a
- Rated speed n_n

b) Operating with 4-quadrant converter

The behavior of the motor with 4Q converter can be estimated. Please calculate

- the torque ripple dependent on the average voltage?
- the point of maximum current ripple dependent on the average voltage?
- The used semiconductors have a current capability of 30A. How fast can the machine be accelerated from zero to rated speed?