$V = RI \quad \Omega = \frac{V}{A}$

$V = \Omega A$

1 a)

$$0.01\ kg\ m^2\ \ddot{\theta} + \left(0.001\ N_m sec + \frac{0.02\ N_m/A \cdot 0.02\ N_m/A}{10\ \Omega}\right)\dot{\theta} = \frac{0.02\ N_m/A}{10\ \Omega/A} V_a$$

$V^{-1}$

$(0.001 + 0.004)\ N_m sec$

$$0.01\ kg\ m^2\ \ddot{\theta} + 0.005\ N_m sec\ \dot{\theta} = 0.002\ V_a\ N_m V^{-1}$$

$0.002\ N_m$ $V$

$V_a$ $A$

$\Downarrow$

Laplace Transform

$$0.01 s^2 \Theta + 0.005 s \Theta = 0.002 V_a$$

$$\frac{0.02}{0.01 s^2 + 0.005 s} = \frac{\Theta}{V_a}$$

$x(\infty) = \lim_{s \to 0} sX(s)$

$$\lim_{s=0} \frac{s \cdot 0.02}{0.01 s^2 + 0.005} = 0$$

$$0.01\ddot{\theta} + \left(0.001 + \frac{0.02 \cdot 0.02}{10}\right)\dot{\theta} = \frac{0.02}{10} V_a$$

$Tr = \frac{\Theta}{V_a}$

$0.01\ddot{\theta} + 0.00104\dot{\theta} = 0.002 V_a \iff$ Laplace $\quad 0.01 s^2 \Theta + 0.00104 s \Theta = 0.02 V_a$

$$\frac{\Theta}{V_a} = \frac{0.02}{0.01 s^2 + 0.00104 s}$$

Unit Impulse FVT $\to 0$

Unit Step FVT $\to$

$$\lim_{s \to 0} \frac{s}{s} \cdot \frac{0.02}{0.01 s^2 + 0.0104} = \frac{0.02}{0.00104} = 1.923$$

1% error: 1.903

Graphical estimate of 1% error ~45 s

Numerical Answer:

Inverse Laplace: $T = \frac{2}{s+0.104} \cdot \frac{1}{s}$

$$T = \frac{2}{s^2+0.104s}$$