# Modelling dynamic systems in the Laplace domain

## Transfer function examples

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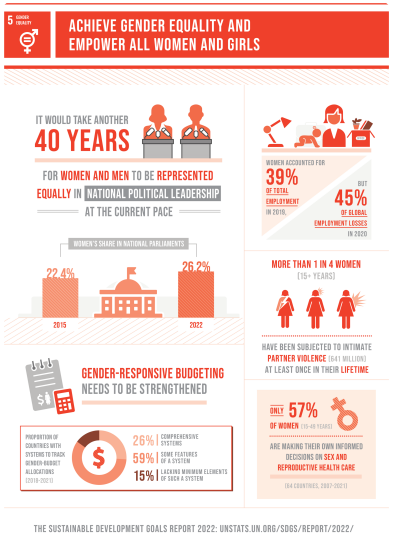
EXTRA CLASS
TOMORROW!!!

Topic: Simulation of dynamical systems



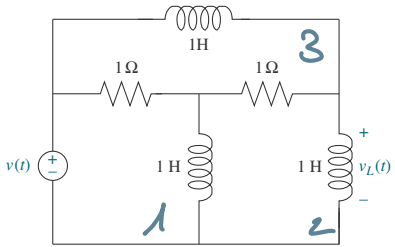

SALA 11
@ 14:00

## Electrical network transfer functions

**Exercise L5E2**: For the given circuit, find the transfer function:

$$G(s) = V_L(s)/V(s)$$

1. Solve the problem two ways: mesh analysis and nodal analysis.
2. Show that the two methods yield the same result.






TEST ANALYSIS

in $M_1 \rightsquigarrow (s+1)I_1(s) - sI_2 - I_3 = V(s)$

in $I_2 \rightsquigarrow -sI_1(s) + (2s+1)I_2(s) - I_3 = 0$

in $I_3 \rightsquigarrow -I_1(s) - I_2(s) + (s+2)I_3 = 0$

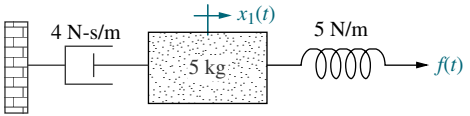
Solving for $I_2$ (with CRAMER)

$$I_2 = \frac{\begin{vmatrix} s+1 & V(s) & -1 \\ -s & 0 & -1 \\ -1 & 0 & s+2 \end{vmatrix}}{\begin{vmatrix} s+1 & -s & -1 \\ -s & 2s+1 & -1 \\ -1 & -1 & s+2 \end{vmatrix}} = \frac{(s^2+2s+1)V(s)}{s(s^2+5s+2)} \Rightarrow V(s) = \frac{s(s^2+5s+2)}{s^2+2s+1} I_2$$

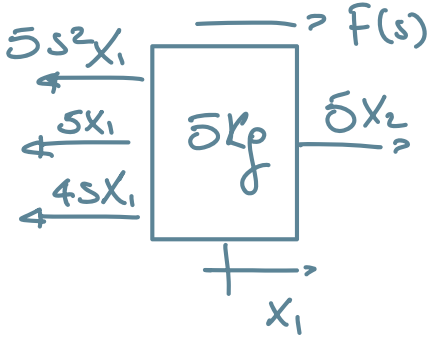
$$V_L(s) = sI_2 \rightsquigarrow \frac{V_L(s)}{V(s)} = \frac{s^2+2s+1}{s^2+5s+2}$$

## Translational mechanical system transfer functions

**Exercise L5E3**: Find the transfer function, $G(s) = X_1(s)/F(s)$, for the system below:






$X_1(s)$ = mass displ.

$X_2(s)$ = spring displ.

$$(5s^2+4s+5)X_1(s) - 5X_2(s) = 0$$

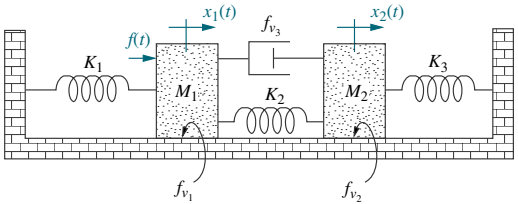
$$-5X_1(s) + 5X_2(s) = F(s)$$

$$(5s^2+4s)X_1(s) = F(s)$$

$$\frac{X_1(s)}{F(s)} = \frac{1}{s(5s+4)}$$

## Translational mechanical system transfer functions

**Exercise L5E4**: Find the transfer function, $X_2(s)/F(s)$, for the system below:






SOLVED in NISE (6th edition)
EXAMPLE 2.17