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PW3: Transfer function and its response using MATLAB-Simulink

Objective:

The objective of the practical work is to learn the necessary MATLAB commands for modelling and simplifying functional diagrams of linear control system using both Script and Simulink blocks.

Description:

In this Practical Work, student must find the differential equation (D.E) of the electrical circuit in Figure 1. After that he will calculate the Laplace transform of this D.E $\boldsymbol{H(s)} = \frac{V_{out}(s)}{V_{in}(s)}$.

Resistor: ***R = 1.3 Ohm***
Inductor: ***L = 0.02 H***
Capacitor: ***C = 0.025 F***

Instructions:

- **Step 1:** Create a new Script in MATLAB by pressing on ***CTRL + N***
- **Step 2:** Enter all the parameters of the electrical circuit in this Script.
- **Step 3:** After you calculate the transfer function, you need to enter both **numerator** and **denominator** of this transfer function $H(s) = \frac{V_{out}(s)}{V_{in}(s)} = \frac{\frac{1}{L.C}}{s^2+\frac{R}{L}.s+\frac{1}{L.C}}$ Using:

  *>> num = [1/L*C];*
  *>> den = [1 , R/L , 1/L*C];*
- **Step 4:** calculate the transfer function using MALAB using this instruction:

  >> H = tf(num , den);
- **Step 5:** Display this transfer function using :
  >> disp(H);

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- **Step 6:** Calculate the zeros (*the roots of the numerator*) of this transfer function using:

  >> zero(H);

- **Step 7:** Calculate the poles (*the roots of denominator*) of this transfer function using:

  >> pole(H);

- **Step 8:** Draw the **Pole – Zero Map** of the system H(s) using:

  >> pzmap(H);

- **Step 9:** Put the system H(s) in the closed loop system with a feedback of one using:

  >> sys = feedback(H,1);

- **Step 10:** Draw **the step response** of the system H(s) using:

  >> step(H);

- **Step 11:** Draw **the impulse response** of the system H(s) using:

  >> impulse(H);

- **Step 12:** Draw **the step response** of the system sys(s) using:

  >> step(sys);

- **Step 13:** Draw **the impulse response** of the system sys(s) using:

  >> impulse(sys);

- **Step 14:** Extract the step response characteristics (*Rise Time, Settling Time, Overshoot, Peak, Steady State Value*) using:
  - *step_info.RiseTime*
  - *step_info.SettlingTime*
  - *step_info.Overshoot*
  - *step_info.Peak*
  - *step_info.SteadyState*

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Starting Simulink

Simulink is started from the MATLAB command prompt by entering the following command:

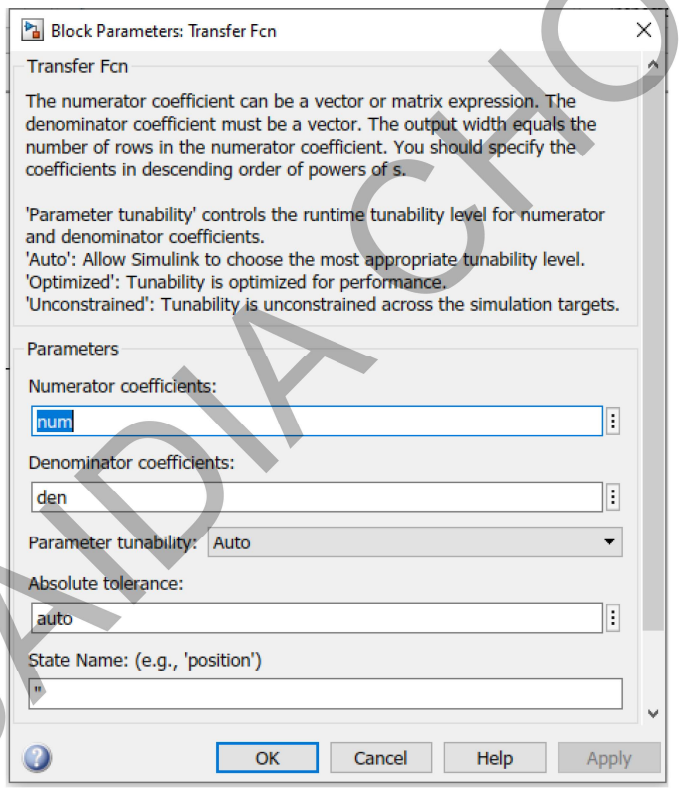
>> ***simulink***

Create a new model in Simulink. Then look for transfer function block in the Simulink library,

Simulink >> Continuous >> Transfer Fcn

Drag and drop the transfer function block in the Simulink model window.

Change the parameters of the Transfer function block as below:



Save your Script and your Simulink model in a new folder.

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