Consider mathematical dynamical system model, described by following differential equations:

$$\dot{v} = -5 \cdot v + \omega + 0.1 \cdot |F|,$$

$$\dot{\omega} = v - \omega\,,$$

where *F* [Nm] is a force acting on the system, which we can manipulate, ω [rad/s] is angular velocity and *v* [m/s] is linear velocity, which we measure.

Tasks:

1) Decide state variables, inputs, and outputs of the system.
2) Implement mathematical model in Simulink. Do not forget about static nonlinearities.
3) Create linear approximation of the model in an operating point, where ***v = 0 m/s***:
   a) Find analytical condition for the operating point to be an equlibrium. **(0.2 b)**
   b) Linearize the system in said point:
      i) Consider the static nonlinearity at the system input **(0.2 b)**
      ii) Neglect the static nonlinearity at the system input **(0.2 b)**
   c) Compare responses of the original and the linearizad model. Discuss suitable signal shapes for validating your linearization.
      i) Consider the static nonlinearity at the system input **(0.2 b)**
      ii) Neglect the static nonlinearity at the system input **(0.2 b)**
4) Create linear approximation of the model in an operating point, where ***v = 10 m/s***:
   a) Find analytical condition for the operating point to be an equlibrium. **(0.2 b)**
   b) Linearize the system in said point:
      i) Consider the static nonlinearity at the system input **(0.2 b)**
      ii) Neglect the static nonlinearity at the system input **(0.2 b)**
   c) Compare responses of the original and the linearizad model. Discuss suitable signal shapes for validating your linearization.
      i) Consider the static nonlinearity at the system input **(0.2 b)**
      ii) Neglect the static nonlinearity at the system input **(0.2 b)**

Consider mathematical dynamical system model, described by following differential equations:

$$\dot{v} = -5 \cdot v \cdot \omega + 0.1 \cdot |F|,$$

$$\dot{\omega} = v - \omega\,,$$

where *F* [Nm] is a force acting on the system, which we can manipulate, ω [rad/s] is angular velocity and *v* [m/s] is linear velocity, which we measure.

Tasks:

Repeat tasks 1 – 4