Signal-flow graphs are a good way to simulate a transfer function. In this exercise you will learn how to implement signal-flow graphs in Simulink and use them to study system response.

1. Find a signal-flow graph that corresponds to the phase-variable realization of the following transfer function:

   \[ T(s) = \frac{s + 2}{(s - 3)(s^2 + 2s + 2)} \]

   Write also the matrices that describe this system in the state-space form.

2. Using the \texttt{ss} function in Matlab define the state space model of the system. Use the \texttt{tf} function to verify that your state space model corresponds to the transfer function \( T(s) \).

3. Implement the signal-flow graph above in Simulink. Plot the response of the system to the unit step input. What can you say about this system?

4. To improve the performance of the system we can design a feedback controller. If \( u(t) \) is the input signal and \( x \) is the state, the so-called state feedback controller is described by equation:

   \[ u = v - Kx \]

   where \( v \) is the new input and \( K \) is a \( 1 \times 3 \) vector called the gain vector. Modify the signal-flow graph above to implement a state feedback controller and plot the step response of the resulting system for:

   (a) \( K = [8 \ 8 \ 4] \)
   (b) \( K = [5 \ 5 \ 3] \)
   (c) \( K = [12 \ 14 \ 6] \)

5. Based on your analysis, suggest the best controller for the system.

Print all the plots and submit them with your report.