Course „Control Systems 2“

Exercise Sheet 9

Task 22:

Consider the LTI SISO system with the state differential equation (see Task 20 on Exercise Sheet 8)

$$\underline{\dot{x}} = \begin{bmatrix} 1 & -4 \\ 2 & -3 \end{bmatrix} \underline{x} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

a) Can we move the eigenvalues of the closed-loop system to arbitrary places by a suitable state feedback controller? Why (not)?

b) Determine the particular state feedback controller which moves the closed-loop eigenvalues to $\lambda_{C,1} = \lambda_{C,2} = -5$.

c) Could we also move the closed-loop eigenvalues to $\lambda_{C,1} = \lambda_{C,2} = +5$? Why is this choice of closed-loop eigenvalues not reasonable?

Task 23:

Consider the electrical system described in Task 1 (see Exercise Sheet 1).

a) Show that this system is completely controllable, even if the second input (the voltage source u_2) is replaced by a short-circuit. Write down the state equations of the resulting SISO system in matrix form.

b) Calculate the feedback control law for the resulting system of subtask a) which realizes the closed-loop eigenvalues $\lambda_{C,1}$ and $\lambda_{C,2}$.
<u>Note:</u> Determine the entries of the vector k^T in general form depending on the plant parameters (R, L and C) and on the desired closed-loop eigenvalues ($\lambda_{C,1}$ and $\lambda_{C,2}$).