

Homework II Mathematical Models of Systems, winter '17/'18

Hand out: February 20th

Hand in: March 5th (by mail: only pdf!)

- It is allowed to discuss the problems with your colleagues.
- Cooperation in groups of two people of approximately the same level is allowed.
- Everybody hands in his or her *own* version.
- It is not allowed to copy from each other.
- The numbers of the exercises refer to the numbering in the book. Refer to the conversion table on the web site.

1. Exercises 4.2, 4.6, 4.8 (you only have to construct a *state*, state equations are not required), 4.22.
2. Exercises 5.8, 5.10 (remark: in (c) and (d) by *without calculation* we mean *without calculating an input function*), 5.12, 5.13.
3. Exercise 6.2 (3). Exercise 6.3 (4), Note: In the right hand side of (b) \bar{q}_1 should be q_1 . This was corrected in the pdf.
4. Additional exercise:

We have seen that the property of state and first-order representations of the form (4.9) (see book) are closely related. Consider, however, the autonomous behavior \mathcal{B} described by $R(\frac{d}{dt})x = 0$, where $R(\xi)$ is given by

$$R(\xi) = \begin{bmatrix} 3 + 3\xi & 2 + 5\xi + \xi^2 \\ -5 + 3\xi^2 & -5 - 4\xi + 4\xi^2 + \xi^3 \end{bmatrix}.$$

Prove that this system is a state space representation with x as the state. Hint: Premultiply $R(\xi)$ by a suitable unimodular matrix to obtain a polynomial matrix in which only first-order polynomials appear.