

TKP4140 Process Control. Autumn 2021. Schedule / updated as we go along

Week (lectures)	Week 2021	Topic lectures (book chapters from Seborg In parenthesis)	Exercise (out Wednesday, help next Wednesday 12-14, hand in Friday at 16:00, solution Monday)
1 (1-3)	34	Control fundamentals («crash course, part 1») NOTE: First lectures are 1015-1300 on Wednesday 25 August 2021 in room K5 (in building K5)	Ex.1 reactor control structure. "Shower process", Help session is the following Wednesday, so 01 Sep. 1215-1400 in K5.
2 (4-6)	35	Intro to dynamics and SIMC PID tuning («crash course, part 2») (Skogestad ch. 11)	Ex.2. Distillation. Modelling + control (Simulink) EXTRA: Thursday 31 Aug 17-19 (K5): Introduction to Matlab and Simulink
3 (7-9)	36	Models: balances, state space form, linearization. Simulation (Ch.2, Skogestad ch. 11)	Ex.3 Linearization, Laplace
4 (10-12)	37	Laplace (App. A), Transfer functions, Poles and zeros, responses, time delay, response of first- and second-order systems, (ch. 3-5)	Ex.4 Transfer functions Thu. Lecture project part 1 (Simulink). 15-17, (K5)
5 (13-15)	38	Continue responses, 2 nd order system (ch.4), block diagrams, Closed-loop response Note: Wed 22 sep 12-14: Room change: R D4-132 (4th floor)	Ex.5. 2 nd order response (Simulink) Lab. In 2nd floor K4 (required for all students)
6 (16-18)	39	Zeros, FOD approx, half rule (ch.5). Closed-loop response (ch.10), SIMC rules	Ex.6 (closed-loop TF, SIMC).
7 (19-21)	40	Derivation of SIMC PID tuning rules (ch. 11). PID tuning, ZN rule. PID implementation, windup, bumpless transfer, discrete control (7.6).	Ex.7. Closed-loop responses (Ex.1 revisit) Friday 08 Oct. 2021: Project part1 deadline
8 (22-24)	41	Midterm week. No lectures. Friday 15 Oct..10-12 Midterm (90 min.). Room S3.	Ex.8: Tuning ZN+Shams Wed: Lecture project part 2: 10-12, (K5)
9 (25-27)	42	Stability, closed-loop poles, Routh Hurwitz, effect of feedback (root locus). Start frequency analysis	Ex.9: Routh-Hurwitz, complex no.s
10 (28-30)	43	Frequency analysis (ch. 13), stability conditions, robustness,	Ex. 10: Bode diagrams. Friday: 29 Oct 2021 Project part 2 deadline
11 (31-33)	44	Freq. Analysis, continued. Advanced process control, cascade	Ex. 11: Bode stability condition. GM, PM Tue: Lecture project part 3 17-19, (K5)
12 (34-36)	45	More advanced control, feedforward, selectors, split range control RGA, Cascade control, feedforward control (ch. 14, 15). Industrial examples.	Ex.12: Feedforward, cascade
13 (37-39)	46	More examples. MIMO control. RGA, Decoupling	Ex.13: RGA, decoupling, feedforward Friday: 19 Nov 2021 Project deadline.
14	47	MPC (ch. 16), Controllability analysis, summary	

(40-42)			
---------	--	--	--

Instructor: Professor Sigurd Skogestad (room K4-211). Phone 91371669 (mob), 735 94154 (office). Email: skoge@ntnu.no

Lectures: Wednesday 10:15 – 12:00 (K5)

Friday 09:15 – 10:00 (K5)

Exercises: Wednesday 12:15 – 14:00 (K5). *May have lectures instead some weeks.*

Project help sessions : 2 sessions each week (3x3 weeks)

Instructors exercises/lab/project

vit.ass. David Perez Pineiro (main responsible)

vit.ass. Zawadi Mdoe

vit.ass. Lucas Ferreira

stud.ass. Megha Rajasekhar , meghar@stud.ntnu.no

stud.ass. Mats Kulås, matsku@stud.ntnu.no

stud.ass. Maren Sofie Lia, marensli@stud.ntnu.no

Required exercises: 50% + required lab + required project

Grading: 60% final exam, 20% midterm, 20% lab/project (lab 5% and project 15%)

Note that the midterm will only count positive. If you do not take the midterm or if the midterm grade is lower than on the final exam, then the final exam will count 80% and the midterm 0%

Midterm test (15 Oct. 2021, 10-12): 90 min written test. No notes or books allowed. Bring pen/pencil, allowed calculator and student ID card.

Final exam (18 Dec. 2021, 9-13): 4 hour written exam. You may bring one (1) A4 double-sided piece of paper with your handwritten notes to the exam. No other books or help is allowed Standard calculator is allowed.

Course material:

- D.E. Seborg, T.F. Edgar, D.A. Mellichamp, F.J. Doyle: Process Dynamics and Control, Wiley, 4th ed. 2019.
- S. Skogestad: Chemical and Energy Process Engineering, CRC Press, 2009, Chapter 11 on “Process Dynamics” (available on course [home page](#))

More information: <http://www.ntnu.edu/studies/courses/TKP4140/2021>