Robust and Nonlinear Control Design (EEN050/ESS076) - Exam guide

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Baseline information

1. Approved lab+assignments (3.5 c.)

2. Written exam (Grading TH, 3,4,5, 4c), standard 4 hours session. You need to be remotely supervised and ID-checked via Zoom. You need to have a computer/device with camera and microphone. More info about Chalmers proctored remote exams at Link)

3. Random sets of exam questions may randomly be assigned to students.

4. Handwritten solutions are requested (name and cid on each pages). When done, scan/photograph your solutions and compile it into one pdf document. Upload your file to Canvas (submission site closes 30 min after the examination). If the electronic version of the solution is not readable from the file, it will not be assessed (with 0 point).

5. Cooperation with or external help from other person is prohibited during examination! If signs of cooperations/external help are being discovered, *all exams involved will automatically be disqualified* and we will *automatically* report the *case to Chalmers with a request for suspension at Swedish Higher Education Authority*.

6. We may call students for oral post-check of solutions in the exam period (within a few days after the exam). Then, students will be asked (with short notice) to explain their solutions or answers.

7. All other aids can be used (books, notes, Matlab, etc.).

8. Teacher(s) will online be available. Examination results will be advertised approx 10 days after the exam. Inspection of results via Zoom.

Preparation I

- Primarily, use lecture slides, videos for preparation (40 + examples!!!).
- Excercise session (resolve session related excercises, additional ones, 2 problem solving manuals, in-book ones)
- Sample exam with solutions.
- Assignments, lab reports.
- Quizzes (weekly, epilog quiz)

Course textbooks:

📄 [R] Multivariable Feedback Control: Analysis and Design
S Skogestad and I Postlethwaite
ISBN: 9780470011683, Wiley

📄 [NL] Nonlinear systems
HK Khalil
ISBN 10: 0132280248 / ISBN 13: 9780132280242 Prentice Hall

Preparation II

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The following chapters in the book are relevant to the course and to the exam.

L #	Topics	slides+chapter
1	PM, Intro, Linear systems	s+(1[R]), 4.1-4.8[R]
2	Signals and system norms	s+4.9-4.11[R]
3	Uncertainty modeling I (interconnection, weights)	s+3.8[R], 7.1-7.4[R], 8.1-8.3[R]
4	Q1, Uncertainty modeling, analysis II (layouts)	s+3.8[R], 7.1-7.4[R], 8.1-8.3[R]
5	Robust synthesis I ($\mathscr{H}_\infty$ state-feedback, $\mathscr{H}_\infty$ filter)	s
6	Q2, Robust synthesis II ($\mathscr{H}_\infty$ output feedback design)	s+8.4[R]+9.1-9.3[R]
7	Robust synthesis III ($\mathscr{H}_\infty$, $\mathscr{H}_2$ controllers)	s+8.4R+9.1-9.3[R]
8	Q3, LPV design I (LPV models, forms)	s+v
9	LPV design II (obs, reach, stability, LMI)	s+v
10	Q4, LPV III (LMI, $\mathscr{H}_\infty$, $\mathscr{H}_2$ LPV design)	s+v
11	NL modeling (phase-plane, stationary, limit cycles)	1, 7.1[NL]
12	Q5, NL analysis I (Lyapunov, input/output stability)	3.1,3.2,3.3[NL]
13	NL analysis II (passivity)	4,5 [NL]
14	Q6, NL synthesis I (Relative degree, zero dynamics. Exact (Feedback) linearization)	12.1-12.3[NL]
15	NL synthesis II (Tracking)	12.1-12.3[NL]
16	NL synthesis III (Back stepping), Q7, overview	13.2[NL]
16	Exercise, Q, Course overview	

Table: Scheduled lectures

Preparation III

Style of questions:

- Theoretical (definition, explanations, similar to quizzes) up to 10-20%
- Standard calculation excercises (excercise session, additional) up to 80-90%
- Challenging (hidden in between lines) up to 10-20%