FRT010 Automatic Control Basic Course (D E)

Course Program Autumn 2014

1. Lectures

Lectures (30 hours) are held at:

Mondays	week 1–7	15.15–17.00	M:A
Tuesdays	week 1–6	15.15–17.00	M:A
Thursdays	week 1–2	15.15–17.00	M:A

Tore Hägglund is lecturer and course responsible.

2. Exercises

Exercises (30 hours) are held in five groups. Times and places are given below. Detailed program for exercises are given on the last page. Exercise 7 is held at lab facilities at the department.

Group D1	Wed 15–17	M:X2a	Fri 10–12	M:X2a	Mattias Fält
Group D2	Thu 13–15	M:X1b	Fri 8–10	M:X2b	Adam Bäckström
Group D3	Wed 15–17	M:X2b	Fri 8–10	M:X2a	Martin Karlsson
Group E1	Wed 10–12	M:X2a	Thu 13–15	M:X2a	Martin Hast
Group E2	Wed 13–15	M:X2b	Fri 13–15	M:X2b	Adam Bäckström

3. Lab Exercises

In the course there are three mandatory lab exercises. These labs are rather extensive and for them to be meaningful you need to prepare. Except for the first lab, there are mandatory home problems, which you should be able to present at the start of the laboration. The second lab exercise also starts with a short test. You must answer the questions in the test correctly, and you must have solved the mandatory home problems to be allowed to participate in the laboration. Note that you are not allowed to bring used lab manuals with notes from previous users. No laboratory reports need to be written.

The labs are performed during the hours 8.15–12.00, 13.15–17.00 or 17.30–21.15. The lab facilities are on the bottom floor in the M-building. You need to sign up to do the lab. Signup lists are available on the course home page, see

`http://www.control.lth.se/Education/EngineeringProgram/FRT010_ED.html`

The signup lists are open during the week before the lab starts. Note that you must sign up during this week. If you are unable to attend the lab you should report this to the administrators or lab responsible. Persons that have missed signing up in time or been absent from a lab without proper cause will have to do the lab the next time the course is given. This is however often already in the next study period, since the same labs are used for most other programs.

Exercise 7 is a computer exercise and booked in the same way as the labs. This exercise is not mandatory, though highly recommended, and the booking is only to even out the load between the groups.

Lab	When	Signup	Responsible
1	week 2–3	week 1	Mahdi Ghazaei
2	week 4–5	week 3	Mahdi Ghazaei
3	week 6–7	week 5	Yang Xu
Ex. 7	week 3	week 2	Tore Hägglund

4. Interactive Computer Tools

In order to facilitate the learning and understanding of some of the concepts used in the course there are interactive computer tools available for free download from

`aer.ual.es/ilm/`

The module *Modeling* is suitable for studying model descriptions. At exercise 7 you have the opportunity for supervised use of this module in our lab facilities.

5. Literature

The course is covered by 4 compendia sold by KF:

Reglerteknik AK – Föreläsningar (Lectures)
Reglerteknik AK – Exempelsamling (Exercises and solutions)
Reglerteknik AK – Laborationer (Lab manual)
Reglerteknik – Formelsamling (Collection of formulae)

The last three compendia are also available for free download at `www.control.lth.se`. You are allowed to use the 'Formelsamling' on the exam.

For those interested in more reading we recommend Glad & Ljung: *Reglerteknik — Grundläggande teori* (Studentlitteratur 2006), Lennartson: *Reglerteknikens grunder* (Studentlitteratur 2002), or Åström & Murray: *Feedback Systems: An Introduction for Scientists and Engineers* (Princeton 2008), available for free at `www.cds.caltech.edu/~murray/amwiki`.

6. Exam

The written exam is 5 hours long. You may use 'Formelsamling', standard tables and calculators (not preprogrammed with e.g. Bode diagrams though). The grades are: fail, 3, 4 or 5.

The exam is on Tuesday October 28, 8–13 in MA10.

Weekly Program

Here is a weekly program with lectures=föreläsningar (F), exercises=övningar (Ö), and labs.

Vecka	Datum	Aktivitet	
36	1 sep	F1:	Kursöversikt. Introduktion. PID-regulatorn. Lab 1.
	2 sep	F2:	Processmodeller. Linjärisering. Blockschema.
	4 sep	F3:	Impuls- och stegsvarsanalys.
		Ö1:	Processmodeller. Linjärisering.
		Ö2:	Systemrepresentationer. Blockschema.
37	8 sep	F4:	Frekvensanalys. Samband mellan modellbeskrivningar.
	9 sep	F5:	Återkoppling. Stabilitet.
	11 sep	F6:	Nyquistkriteriet. Stabilitetsmarginaler.
		Ö3:	Poler, nollställen, steg- och impulssvar.
		Ö4:	Frekvensanalys. Bode- och Nyquistdiagram.
	LABORATION 1: Empirisk undersökning av två enkla reglerkretsar.		
38	15 sep	F7:	Känslighet. Stationära fel. Lab 2.
	16 sep	F8:	Tillståndsåterkoppling.
		Ö5:	PID-reglering. Lab 2.
		Ö6:	Nyquistkriteriet. Stabilitetsmarginaler.
		Ö7:	Datorhjälpmedel.
39	22 sep	F9:	Kalmanfiltrering.
	23 sep	F10:	Utsignalåterkoppling. Pol/nollställe-förkortning. Lab 3.
		Ö8:	Stationära fel. Känslighet.
		Ö9:	Tillståndsåterkoppling.
	LABORATION 2: Modellbygge och beräkning av PID-inställning.		
40	29 sep	F11:	Kompensering i frekvensplanet.
	30 sep	F12:	PID-reglering.
		Ö10:	Kalmanfiltrering.
		Ö11:	Kompensering i frekvensplanet.
41	6 okt	F13:	Regulatorstrukturer. Implementering.
	7 okt	F14:	Syntesexempel.
		Ö12:	PID-reglering.
		Ö13:	Regulatorstrukturer.
	LABORATION 3: Reglering av flexibelt servo.		
42	13 okt	F15:	Repetition.
		Ö14:	Syntes.
		Ö15:	Repetition.
44	28 okt	8–13	TENTAMEN

Department Offices

The Department offices are located in the M-building. Administrators are on the 5th floor. The course lab is on the bottom floor southwest wing. We also have facilities on floor 2, 3, and 5.

Phone and addresses

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More information about the department are available on the home page
`http://www.control.lth.se`

Exercises

Ö = Done on exercise. H = Suggested home exercises/repetition for exam

Ö1 Processmodeller. Linjärisering.
Ö: 1.1, 1.2, 1.7
H: 1.5a-c, 1.6, 1.9

Ö2 Systemrepresentationer. Blockschema.
Ö: 2.1, 2.14ab, 2.15
H: 2.2ab, 2.16ab

Ö3 Poler, nollställen, steg- och impulssvar.
Ö: 2.5, 2.9, 2.11, 2.13
H: 2.6

Ö4 Frekvensanalys. Bodediagram. Nyquist-diagram.
Ö: 3.1, 3.2, 3.4bd, 3.5b, 3.7
H: 3.4ac, 3.5a, 3.6

Ö5 PID-reglering. Lab 2.
Ö: 4.1, Förberedelseuppgifter 3.1 och 3.6 i Lab 2, 4.9
H: 6.3, 6.4

Ö6 Nyquistkriteriet. Stabilitetsmarginaler.
Ö: 4.13, 4.15, 4.17, 4.18
H: 4.12, 4.14, 4.19

Ö7 Datorhjälpmedel.
Ö: 9.1, 9.2, 9.3

Ö8 Stationära fel. Känslighet.
Ö: 4.11, 4.2, 4.6, 4.7, 4.4
H: 4.3, 4.5

Ö9 Tillståndsåterkoppling. Styrbarhet.
Ö: 5.5, 5.6, 5.8, 5.10, 5.11
H: 5.2

Ö10 Kalmanfiltrering. Observerbarhet. Lab3.
Ö: 5.3, 5.12, 5.9
H: 5.13

Ö11 Kompensering i frekvensplanet.
Ö: 6.11, 6.12, 6.13, 6.14
H: 6.15

Ö12 PID-reglering.
Ö: 6.5, 6.2, 6.7, 6.8
H: 6.6, 6.9

Ö13 Regulatorstrukturer.
Ö: 7.1, 7.6, 7.8, 7.9ab
H: 7.2, 7.5, 7.9c

Ö14 Syntes.
Ö: 8.1
H: 8.2

Ö15 Gammal tenta.