FRT010 Automatic Control Basic Course (CMN)

Course Program Autumn 2014

1. Lectures

Lectures (30 hours) are held at:

Mondays	week 1–6	8.15–10.00	M:A
Wednesdays		8.15–10.00	M:A
Thursdays	week 1–2	8.15–10.00	M:A

Tore Hägglund is lecturer and course responsible.

2. Exercises

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

Group C	Wed 10–12	E:3308	Fri 13–15	E:3336	Iulia Stoica
Group M1	Wed 13–15	M:R	Thu 10–12	M:R	Adam Bäckström
Group M2	Wed 13–15	M:M1	Thu 15–17	M:M1	Victor Millnert
Group M3	Wed 15–17	M:L1	Thu 15–17	M:Q	Mahdi Ghazaei
Group M4	Wed 15–17	M:L2	Fri 10–12	M:L2	Adam Bäckström
Group N1	Wed 15–17	MH:331	Fri 8–10	MH:331	Olof Troeng
Group N2	Wed 13–15	MH:229	Fri 8–10	MH:229	Mattias Fält

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_CMN.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	week 5	Gabriel Ingesson
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 allo 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. You may use 'Formelsamling', standard tables and calculators (not preprogrammed with e.g. Bode diagrams though). The grades are: fail, 3, 4 or 5.

Weekly Program

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

Week	Date	Activity	
45	3 Nov	F1:	Kursöversikt. Introduktion. PID-regulatorn. Lab 1.
	5 Nov	F2:	Processmodeller. Linjärisering. Blockschema.
	6 Nov	F3:	Impuls- och stegsvarsanalys.
		Ö1:	Processmodeller. Linjärisering.
		Ö2:	Systemrepresentationer. Blockschema.
46	10 Nov	F4:	Frekvensanalys. Samband mellan modellbeskrivningar.
	12 Nov	F5:	Återkoppling. Stabilitet.
	13 Nov	F6:	Nyquistkriteriet. Stabilitetsmarginaler.
		Ö3:	Poler, nollställen, steg- och impulssvar.
		Ö4:	Frekvensanalys. Bode- och Nyquistdiagram.

LABORATION 1: Empirisk undersökning av två enkla reglerkretsar.

Week	Date	Activity	
47	17 Nov	F7:	Känslighet. Stationära fel. Lab 2.
	19 Nov	F8:	Tillståndsåterkoppling.
		Ö5:	PID-reglering. Lab 2.
		Ö6:	Nyquistkriteriet. Stabilitetsmarginaler.
		Ö7:	Datorhjälpmedel.
48	24 Nov	F9:	Kalmanfiltrering.
	26 Nov	F10:	Utsignalåterkoppling. Pol/nollställe-förkortning. Lab 3.
		Ö8:	Stationära fel. Känslighet.
		Ö9:	Tillståndsåterkoppling.

LABORATION 2: Modellbygge och beräkning av PID-inställning.

Week	Date	Activity	
49	1 Dec	F11:	Kompensering i frekvensplanet.
	3 Dec	F12:	PID-reglering.
		Ö10:	Kalmanfiltrering.
		Ö11:	Kompensering i frekvensplanet.
50	8 Dec	F13:	Regulatorstrukturer. Implementering.
	10 Dec	F14:	Syntesexempel.
		Ö12:	PID-reglering.
		Ö13:	Regulatorstrukturer.

LABORATION 3: Reglering av flexibelt servo.

Week	Date	Activity	
51	17 Dec	F15:	Repetition.
		Ö14:	Syntes.
		Ö15:	Repetition.

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 adresses

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More information about the department is 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. Nyquistdiagram.
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.