FRT010 Automatic Control Basic Course (F I Pi)

Course Program Spring 2016

1. Lectures

Lectures (30 hours) are held at:

Mondays	week 1–6	15.15–17.00	M:A
Tuesdays	week 1–2	8.15–10.00	M:A
Wednesdays		13.15–15.00	M:A

Bo Bernhardsson 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 F1	Tue 10–12	M:X2ab	Thu 10–12	M:X2ab	Marcus Thelander Andren
Group F2	Tue 15–17	M:X2ab	Fri 10–12	M:X2ab	Märta Paulsson
Group I1	Wed 15–17	M:X2ab	Thu 13–15	M:X2ab	Yang Xu
Group I2	Tue 13–15	M:X2ab	Wed 10–12**	M:X2ab	Tove Jungenfeldt
Group I3	Tue 8-10*	M:X2ab	Thu 8–10	M:X2b	Christine Sjölander
Group Pi	Tue 10–12	M:X1a	Fri 13–15	M:X2a	Gautham Nayak Seetanadi

* Except that **Group I3** has exercise 1 Tue 19/1 10–12 M:M1 and exercise 3 Mon 25/1 13–15 M:X2ab and the exercise Tue 1/3 8-10 is moved to Fri 4/3 8-10
** **Group I2**: Except for 17/2 and 24/2 when it is moved to Wed 8-10 instead.

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. For Lab2 and Lab3 there are mandatory home problems, which you must be able to present at the start of the laboration. The second lab exercise also starts with a short test, and you must answer the questions correctly to be allowed to participate in the laboration. Lab manuals are sold at KF-Sigma. No laboratory reports need to be written.

The labs are performed during the hours 8.15–12.00, 13.15–17.00. They are not included in the schedule from the LTH schedule generator. The lab facilities are on the bottom floor in the M-building. You need to sign up to do the labs. Signup lists are available on the course home page, see

`http://www.control.lth.se/Education/EngineeringProgram/FRT010_FIPi.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	Marcus Thelander Andren
2	week 4–5	week 3	Mattias Fält
3	week 6–7	week 5	Fredrik Magnusson
Ex. 7	week 3	week 2	Bo Bernhardsson

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. Piazza.com

We will use the tool Piazza during the course, mainly for online discussion, questions and answers. The signup link is `piazza.com/lu.se/spring2016/frt010`

6. 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`.

7. 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 Wednesday March 16, 08–13 at Victoria stadium..

Weekly Program

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

Vecka	Datum	Aktivitet	
4	18 jan	F1:	Kursöversikt. Introduktion. PID-regulatorn. Lab 1.
	19 jan	F2:	Processmodeller. Linjärisering. Blockschema.
	20 jan	F3:	Impuls- och stegsvarsanalys.
		Ö1:	Processmodeller. Linjärisering.
		Ö2:	Systemrepresentationer. Blockschema.
5	25 jan	F4:	Frekvensanalys. Samband mellan modellbeskrivningar.
	26 jan	F5:	Återkoppling. Stabilitet.
	27 jan	F6:	Nyquistkriteriet. Stabilitetsmarginaler.
		Ö3:	Poler, nollställen, steg- och impulssvar.
		Ö4:	Frekvensanalys. Bode- och Nyquistdiagram.
	LABORATION 1: Empirisk undersökning av två enkla reglerkretsar.		
6	1 feb	F7:	Känslighet. Stationära fel. Lab 2.
	3 feb	F8:	Tillståndsåterkoppling.
		Ö5:	PID-reglering. Lab 2.
		Ö6:	Nyquistkriteriet. Stabilitetsmarginaler.
		Ö7:	Datorhjälpmedel.
7	8 feb	F9:	Kalmanfiltrering.
	10 feb	F10:	Utsignalåterkoppling. Pol/nollställe-förkortning. Lab 3.
		Ö8:	Stationära fel. Känslighet.
		Ö9:	Tillståndsåterkoppling.
	LABORATION 2: Modellbygge och beräkning av PID-inställning.		
8	15 feb	F11:	Kompensering i frekvensplanet.
	17 feb	F12:	PID-reglering.
		Ö10:	Kalmanfiltrering.
		Ö11:	Kompensering i frekvensplanet.
9	22 feb	F13:	Regulatorstrukturer. Implementering.
	24 feb	F14:	Syntesexempel.
		Ö12:	PID-reglering.
		Ö13:	Regulatorstrukturer.
	LABORATION 3: Reglering av flexibelt servo.		
10	2 mars	F15:	Repetition.
		Ö14:	Syntes.
		Ö15:	Repetition.
11	16 mars	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. 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, 5.8, 5.10, 5.11
H: 5.2, 5.6

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, 7.9
H: 7.2, 7.5

Ö14 Syntes.
Ö: 8.1
H: 8.2

Ö15 Gammal tenta.