

FRT010 Automatic Control Basic Course (F I Pi)

Course Program Spring 2014

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

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 F1	Tue 10–12	M:X1b	Fri 8–10	M:X2a	Yang Xu
Group F2	Wed 10–12	M:X2a	Thu 10–12	M:X2a	Victor Millnert
Group F3	Tue 15–17	M:L2	Fri 13–15	M:X2a	Per Johnsson
Group I1	Tue 15–17	M:Q	Fri 10–12	M:X2b	Iulia Stoica
Group I2	Tue 15–17	M:Q	Fri 13–15	M:X2b	Adam Bäckström
Group I3	Tue 10–12	M:X2a	Fri 8–10	M:X2b	Gustav Nilsson
Group I4	Wed 10–12	M:X2b	Thu 10–12	M:X2b	Martin Karlsson
Group Pi	Tue 10–12	M:X1a	Fri 10–12	M:X2a	Fredrik Magnusson

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 starts with a short test, and you must answer the questions correctly to be allowed to participate in the laboration. No laboratory reports need to be written. Lab manuals are sold at KF-Sigma.

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_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	Alina Rubanova
2	week 4–5	week 3	Alina Rubanova
3	week 6–7	week 5	Gustav Nilsson
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 March 11, 14–19 at Victoria stadium..

Weekly Program

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

Vecka	Datum	Aktivitet
4	20 jan	F1: Kursöversikt. Introduktion. PID-regulatorn. Lab 1.
	21 jan	F2: Processmodeller. Linjärisering. Blockschema.
	22 jan	F3: Impuls- och stegvarsanalys.
		Ö1: Processmodeller. Linjärisering.
		Ö2: Systemrepresentationer. Blockschema.
5	27 jan	F4: Frekvensanalys. Samband mellan modellbeskrivningar.
	28 jan	F5: Återkoppling. Stabilitet.
	29 jan	F6: Nyquistkriteriet. Stabilitetsmarginaler.
		Ö3: Poler, nollställen, steg- och impulssvar.
		Ö4: Frekvensanalys. Bode- och Nyquistdiagram.
		LABORATION 1: Empirisk undersökning av två enkla reglerkretsar.
6	3 feb	F7: Känslighet. Stationära fel. Lab 2.
	5 feb	F8: Tillståndsåterkoppling.
		Ö5: PID-reglering. Lab 2.
		Ö6: Nyquistkriteriet. Stabilitetsmarginaler.
		Ö7: Datorhjälpmedel.
7	10 feb	F9: Kalmanfiltrering.
	12 feb	F10: Utsignalåterkoppling. Pol/nollställe-förkortning. Lab 3.
		Ö8: Stationära fel. Känslighet.
		Ö9: Tillståndsåterkoppling.
		LABORATION 2: Modellbygge och beräkning av PID-inställning.
8	17 feb	F11: Kompensering i frekvensplanet.
	19 feb	F12: PID-reglering.
		Ö10: Kalmanfiltrering.
		Ö11: Kompensering i frekvensplanet.
9	24 feb	F13: Regulatorstrukturer. Implementering.
	26 feb	F14: Syntesexempel.
		Ö12: PID-reglering.
		Ö13: Regulatorstrukturer.
		LABORATION 3: Reglering av flexibelt servo.
10	5 mars	F15: Repetition.
		Ö14: Syntes.
		Ö15: Repetition.
11	11 mars	14–19 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	Ö8 Stationära fel. Känslighet. Ö: 4.11, 4.2, 4.6, 4.7, 4.4 H: 4.3, 4.5
Ö2 Systemrepresentationer. Blockschema. Ö: 2.1, 2.14ab, 2.15 H: 2.2ab, 2.16ab	Ö9 Tillståndsåterkoppling. Styrbarhet. Ö: 5.5, 5.8, 5.10, 5.11 H: 5.2, 5.6
Ö3 Poler, nollställan, steg- och impulssvar. Ö: 2.5, 2.9, 2.11, 2.13 H: 2.6	Ö10 Kalmanfiltrering. Observerbarhet. Lab3. Ö: 5.3, 5.12, 5.9 H: 5.13
Ö4 Frekvensanalys. Bodediagram. Nyquist-diagram. Ö: 3.1, 3.2, 3.4bd, 3.5b, 3.7 H: 3.4ac, 3.5a, 3.6	Ö11 Kompensering i frekvensplanet. Ö: 6.11, 6.12, 6.13, 6.14 H: 6.15
Ö5 PID-reglering. Lab 2. Ö: 4.1, Förberedelseuppgifter 3.1 och 3.6 i Lab 2, 4.9 H: 6.3, 6.4	Ö12 PID-reglering. Ö: 6.5, 6.2, 6.7, 6.8 H: 6.6, 6.9
Ö6 Nyquistkriteriet. Stabilitetsmarginaler. Ö: 4.13, 4.15, 4.17, 4.18 H: 4.12, 4.14, 4.19	Ö13 Regulatorstrukturer. Ö: 7.1, 7.6, 7.8, 7.9 H: 7.2, 7.5
Ö7 Datorhjälpmedel. Ö: 9.1, 9.2, 9.3	Ö14 Syntes. Ö: 8.1 H: 8.2
	Ö15 Gammal tenta.