

# FRT010 Automatic Control Basic Course (CMN)

Course Program Autumn 2016

## 1. Lectures

Lectures (30 hours) are held at:

Mondays		15.15–17.00	M:A
Wednesdays	week 1–6	8.15–10.00	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 5 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.

<b>Group C</b>	Tue 8–10	M:L1	Thu 13–15	M:L1	Christine Sjölander
– week 1	Wed 10–12	M:L1	Thu 13–15	M:L1	
– week 5	Tue 8–10	M:L1	Thu 13–15	E:1145	
– week 7	Tue 8–10	M:L1	Tue 13–15	E:1145	
<b>Group M1</b>	Wed 15–17	E:1407	Fri 8–10	E:1407	Martin Heyden
– week 7	Tue 15–17	M:M2	Thu 10–12	E:3319	
<b>Group M2</b>	Wed 13–15	E:1407	Thu 10–12	E:3319	Johan Lindberg
– week 3,4,5	Wed 13–15	E:1407	Thu 10–12	E:1407	
– week 6	Thu 10–12	E:1407	Fri 10–12	M:X2b	
– week 7	Mon 13–15	M:L1	Fri 10–12	M:X2b	
<b>Group MD</b>	Thu 10–12	M:X2a	Fri 10–12	E:1407	Gautham Nayak Seetanadi
– week 2	Thu 10–12	M:X2a	Fri 8–10	M:M1	
– week 3	Thu 10–12	M:X2a	Fri 13–15	M:M1	
– week 4,6	Thu 10–12	M:X2a	Fri 13–15	M:M2	
– week 5	Thu 10–12	M:M2	Fri 13–15	M:M1	
– week 7	Wed 15–17	E:1407	Fri 13–15	M:M1	
<b>Group N</b>	Wed 13–15	MH:229	Fri 8–10	MH:229	Yang Xu

## 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](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	Manfred Dellkrantz
2	week 4-5	week 3	Gautham Nayak Seetanadi
3	week 6	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/](http://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](http://www.control.lth.se). You are also 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](http://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.

The exam is on Tuesday January 10, 8–13, at Victoria stadion.

## Weekly Program

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

Week	Date	Activity
44	31 Okt	F1: Kursöversikt. Introduktion. PID-regulatorn. Lab 1.
	2 Nov	F2: Processmodeller. Linjärisering. Blockschema.
	3 Nov	F3: Impuls- och stegsvarsanalys.
		Ö1: Processmodeller. Linjärisering.
		Ö2: Systemrepresentationer. Blockschema.
45	7 Nov	F4: Frekvensanalys. Samband mellan modellbeskrivningar.
	9 Nov	F5: Återkoppling. Stabilitet.
	10 Nov	F6: Nyquistkriteriet. Stabilitetsmarginaler.
		Ö3: Poler, nollställen, steg- och impulssvar.
		Ö4: Frekvensanalys. Bode- och Nyquistdiagram.
	LABORATION 1: Empirisk undersökning av två enkla reglerkretsar.	
46	14 Nov	F7: Känslighet. Stationära fel. Lab 2.
	16 Nov	F8: Tillståndsåterkoppling.
		Ö5: PID-reglering. Lab 2.
		Ö6: Nyquistkriteriet. Stabilitetsmarginaler.
		Ö7: Datorhjälpmedel.
47	21 Nov	F9: Kalmanfiltrering.
	23 Nov	F10: Utsignalåterkoppling. Pol/nollställe-förkortning. Lab 3.
		Ö8: Stationära fel. Känslighet.
		Ö9: Tillståndsåterkoppling.
		LABORATION 2: Modellbygge och beräkning av PID-inställning.
48	28 Nov	F11: Kompensering i frekvensplanet.
	30 Nov	F12: PID-reglering.
		Ö10: Kalmanfiltrering.
		Ö11: Kompensering i frekvensplanet.
49	5 Dec	F13: Regulatorstrukturer. Implementering.
	7 Dec	F14: Syntesexempel.
		Ö12: PID-reglering.
		Ö13: Regulatorstrukturer.
		LABORATION 3: Reglering av flexibelt servo.
50	12 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 addresses

Mika Nishimura (Ladok etc)	222 87 85	5th floor	mika.nishimura@control.lth.se
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Johan Lindberg			johan.lindberg.826@student.lu.se
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Yang Xu	222 32 70	2nd floor	yang.xu@control.lth.se

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: 1.5, 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, 5.6, 5.8, 5.10, 5.11 H: 5.2
Ö3 Poler, nollställena, 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. Nyquistdiagram. 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: 4.15, 4.13, 4.17, 4.18 H: 4.12, 4.14, 4.19	Ö13 Regulatorstrukturer. Ö: 7.1, 7.6, 7.8, 7.9ab H: 7.2, 7.5, 7.9c
Ö7 Datorhjälpmedel. Ö: 9.1, 9.2, 9.3	Ö14 Syntes. Ö: 8.1 H: 8.2
	Ö15 Gammal tenta.