

# FRT010 Automatic Control Basic Course (CMN)

Course Program Autumn 2013

## 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

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.

<b>Group C</b>	Wed 10-12	E:3308	Fri 10-12	E:3308	Jacob Antonsson
<b>Group M1</b>	Wed 13-15	M:Q	Thu 10-12	M:R	Iulia Stoica
<b>Group M2</b>	Wed 13-15	M:M1	Thu 15-17	M:M2	Björn Olofsson
<b>Group M3</b>	Wed 15-17	(*)	Fri 10-12	M:L2	Mahdi Ghazaei
<b>Group M4</b>	Thu 13-15	M:M2	Fri 10-12	M:M1	Victor Millnert
<b>Group N1</b>	Wed 15-17	MH:362D	Fri 13-15	MH:229	Adam Bäckström
<b>Group N2</b>	Wed 15-17	MH:362D	Fri 13-15	MH:331	Per Johnsson

**Schedule exceptions:** Week2: Groups M1,M2,M3, Week3: M2, Week4: C. Please check central schedule in LTH schedule generator.

(\*) The location for Group 3 on wednesdays is irregular; the first exercise is in M:L2, thereafter check in LTH central schedule.

## 3. Lab Exercises

In the course there are 3 mandatory lab exercises. These labs are rather extensive and for them to be meaningful you need to prepare. Therefore each lab exercise is started with a short test. All questions need to be answered correctly for you to be allowed start the laboration. For some labs there are also mandatory home problems, which you should be able to present at the start of the laboration. Some preparations for these labs are reviewed in the lectures and exercises marked 'lab' on page 4. Lab manuals are sold at KF-Sigma. No laboratory reports need to be written.

The labs are done 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 for all 3 labs are available on the course home page from the first course week, see

[http://www.control.lth.se/Education/EngineeringProgram/FRT010\\_CMN.html](http://www.control.lth.se/Education/EngineeringProgram/FRT010_CMN.html)  
Note the last dates for signing up given there.

If you are unable to attend the lab you should report this to the secretary 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	Josefin Berner
2	week 4-5	week 1	Gustav Nilsson
3	week 6	week 1	Gustav Nilsson
Ex. 7	TBD	TBD	Teaching Assistants

## 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. FAQ

There is a collection of some frequently asked questions on the home page.

## 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](http://www.control.lth.se). You are also 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](http://www.cds.caltech.edu/~murray/amwiki).

## 7. 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 Monday December 16, 8–13 in MA08 and MA10.

## Weekly Program

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

Week	Date	Activity
44	28 Oct	F1: Kursöversikt. Introduktion. PID-regulatorn. Lab 1.
	30 Oct	F2: Processmodeller. Linjärisering. Blockschema.
	31 Oct	F3: Impuls- och stegvarsanalys.
		Ö1: Processmodeller. Linjärisering.
		Ö2: Systemrepresentationer. Blockschema.
45	4 Nov	F4: Frekvensanalys. Samband mellan modellbeskrivningar.
	6 Nov	F5: Återkoppling. Stabilitet.
	7 Nov	F6: Nyquistkriteriet. Stabilitetsmarginaler.
		Ö3: Poler, nollställen, steg- och impulssvar.
		Ö4: Frekvensanalys. Bode- och Nyquistdiagram.
LABORATION 1: Empirisk undersökning av två enkla reglerkretsar.		
46	11 Nov	F7: Känslighet. Stationära fel. Lab 2.
	13 Nov	F8: Tillståndsåterkoppling.
		Ö5: PID-reglering. Lab 2.
		Ö6: Nyquistkriteriet. Stabilitetsmarginaler.
		Ö7: Datorhjälpmedel.
47	18 Nov	F9: Kalmanfiltrering.
	20 Nov	F10: Utsignalåterkoppling. Pol/nollställe-förkortning. Lab 3.
		Ö8: Stationära fel. Känslighet.
		Ö9: Tillståndsåterkoppling.
	LABORATION 2: Modellbygge och beräkning av PID-inställning.	
48	25 Nov	F11: Kompensering i frekvensplanet.
	27 Nov	F12: PID-reglering.
		Ö10: Kalmanfiltrering.
		Ö11: Kompensering i frekvensplanet.
49	2 Dec	F13: Regulatorstrukturer. Implementering.
	4 Dec	F14: Syntesexempel.
		Ö12: PID-reglering.
		Ö13: Regulatorstrukturer.
		LABORATION 3: Reglering av flexibelt servo.
50	11 Dec	F15: Repetition.
		Ö14: Syntes.
		Ö15: Repetition.
51	EXAM	

## 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, nollställen, 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: 4.13, 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.