FRTF05 Automatic Control Basic Course (CMN)

Course Program Autumn 2020

Due to the Corona pandemic, this year's course will differ in several ways from previous years of the course. We introduce Canvas to handle the contact between teachers and students. The lectures will, at least at the beginning of the course, be given in the form of pre-recorded videos that are posted in Canvas according to the schedule. The exercises will take place in classrooms, but teachers will not walk around in the room but stay at the board and teach from there. The labs will be carried out individually instead of in pairs and preparation tasks have to be handed in in advance via Canvas. More information will be given at the first lecture.

Canvas

All information about the course, and communication between teachers and students are handled using the Canvas page

https://canvas.education.lu.se/courses/8382

1. Lectures

Lectures (30 hours) are held at:

Mondays	week 1–7	15.15–17.00
Wednesdays	week 1–6	8.15–10.00
Thursdays	week 1–2	15.15–17.00

Tore Hägglund is lecturer and course responsible.

2. Webinars

During a webinar, we discuss the material from the latest lecture. The webinar is held via zoom and led by an exercise leader, but the purpose is for you students to have a chance to discuss the material in a structured way with each other. Before a webinar, it is good if you have watched the lecture or read the course material that belongs to the lecture, so that you can participate in the discussion and get the most out of the webinar.

Tuesdays	week 1–7	10.15–12.00
Thursdays	week 1–5	13.15–15.00
Fridays	week 1–2	10.15–12.00

Frida Heskebeck is responsible for the webinars.

3. Exercises

Exercises (30 hours) are held in four groups. Times and places are given below. Detailed program for exercises are given on the last page. Exercise 7 is a computer exercise that is not provided in classrooms this year. Support will be given using zoom at times presented in Canvas.

Group C					Manu Upadhyaya
– week 1-7	Thu 13–15	E:3308	Fri 10–12	E:3308	
Group M					Johanna Gustafson
– week 1-7	Wed 13–15	KC:M-ALC	Thu 10–12	KC:M-Q	
Group MD					David Ohlin
– week 1-3,5-6	Thu 10–12	KC:M-ALC	Fri 13–15	KC:M-ALC	
– week 4	Thu 10–12	KC:M-ALC	Fri 13–15	KC:I	
– week 7	Thu 10–12	KC:M-M2	Fri 13–15	KC:K	
Group N					Johan Lindberg
– week 1-7	Wed 13–15	MH:229	Fri 8–10	MH:229	

4. 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 must be solved and handed in using Canvas at least 4 working days before your lab session for you 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 lab facilities are on the bottom floor in the KC4-building. You need to sign up to do the lab. Signup lists are available in Canvas.

The signup lists are open durilng a week according to the table below. Note that you must sign up during this week. If you are unable to attend the lab you should report this to the 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.

Lab	**When**	**Signup**	**Responsible**
1	week 2-3	2 Nov - 8 Nov	Frida Heskebeck
2	week 4-5	9 Nov - 16 Nov	Johan Lindberg
3	week 6-7	23 Nov - 30 Nov	Manu Upadhyaya

5. 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. In Exercise 7, this model is used. This exercise is not given on campus, there will be zoom support at several occasions during the third course week.

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 compendia are also available for free download in Canvas. 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) 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. 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 January 13.

Weekly Program

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

Week	Date	Activity	
45	2 Nov	F1:	Kursöversikt. Introduktion. PID-regulatorn. Lab 1.
	4 Nov	F2:	Processmodeller. Linjärisering. Blockschema.
	5 Nov	F3:	Impuls- och stegsvarsanalys.
		Ö1:	Processmodeller. Linjärisering.
		Ö2:	Systemrepresentationer. Blockschema.
46	9 Nov	F4:	Frekvensanalys. Samband mellan modellbeskrivningar.
	11 Nov	F5:	Återkoppling. Stabilitet.
	12 Nov	F6:	Nyquistkriteriet. Stabilitetsmarginaler.
		Ö3:	Poler, nollställen, steg- och impulssvar.
		Ö4:	Frekvensanalys. Bode- och Nyquistdiagram.
	LABORATION 1: Empirisk undersökning av två enkla reglerkretsar.		
47	16 Nov	F7:	Känslighet. Stationära fel. Lab 2.
	18 Nov	F8:	Tillståndsåterkoppling.
		Ö5:	PID-reglering. Lab 2.
		Ö6:	Nyquistkriteriet. Stabilitetsmarginaler.
		Ö7:	Datorhjälpmedel.
48	23 Nov	F9:	Kalmanfiltrering.
	25 Nov	F10:	Utsignalåterkoppling. Pol/nollställe-förkortning. Lab 3.
		Ö8:	Stationära fel. Känslighet.
		Ö9:	Tillståndsåterkoppling.
	LABORATION 2: Modellbygge och beräkning av PID-inställning.		
49	30 Nov	F11:	Kompensering i frekvensplanet.
	2 Dec	F12:	PID-reglering.
		Ö10:	Kalmanfiltrering.
		Ö11:	Kompensering i frekvensplanet.
50	7 Dec	F13:	Regulatorstrukturer. Implementering.
	9 Dec	F14:	Syntesexempel.
		Ö12:	PID-reglering.
		Ö13:	Regulatorstrukturer.
	LABORATION 3: Reglering av flexibelt servo.		
51	14 Dec	F15:	Repetition.
		Ö14:	Syntes.
		Ö15:	Repetition.

Department Offices

The Department offices are located in the KC4-building, on the third floor. The course lab is on the bottom floor northeast wing.

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: 1.5 a-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: 4.15, 4.13, 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.