Université d'Ottawa
Faculté de génie

Département de
génie mécanique

uOttawa

University of Ottawa
Faculty of Engineering

Department of
Mechanical Engineering

MCG 3307: Control Systems II

Winter 2011

Instructor: Dr. Davide Spinello
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phone: 613.562.5800 ext. 2460
office hours: Take an appointment by email

Lectures: VNR 1075
Tuesday 11:30 - 13:00
Friday 13:00 - 14:30

Tutorial: TBT 319, Monday 8:00 - 10:00

Textbook: two editions (fourth and fifth) of the textbook (see below) are allowed. For the rest of the syllabus the two editions will be distinguished by enclosing between square brackets entities referred to the fourth edition (for example "Ch. 6" will be referred to the fifth edition, whereas "[Ch. 6]" will be referred to the fourth edition).

Ogata, K.: *Modern control engineering - Fifth edition.* Prentice Hall, 2009
Ogata, K.: *Modern control engineering - Fourth edition.* Prentice Hall, 2001

Web page: http://by.genie.uottawa.ca/~spinello/webpage/teaching.html

TAs:

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Course Outline

Systems response analysis: Chapter 5
General structure of controllers; First order systems; Higher order systems; Routh's stability criterion; Integral and derivative control actions: effects on systems performance; Steady-state errors.

Root-locus method: Chapter 6 [Chapters 6 and 7]
The concept of root-locus; Rules for constructing root-loci; Root-locus analysis of control systems; Control-systems design by the root-locus approach.

Frequency-response method: Chapter 7 [Chapters 8 and 9]
Response to sinusoidal inputs; Bode diagrams; Polar plots; Experimental determination of transfer functions; Control-systems design by the frequency-response approach.

Description and objectives

This course presents the concepts of transient and steady-state response analysis for control systems, assess the stability of control systems through the root-locus method and the frequency-response method, and teaches methods for designing controllers that correspond to desired system behaviours. Students will develop the capability of analyzing the stability of a system and of designing simple controllers to regulate systems behaviour.

Exams: policy and dates

All tests and exams will be closed book - closed notes. A formula sheet will be provided by the instructor if necessary.

Illegible work and loose sheets will not be graded. If a student cannot attend a test/exam due to a medical condition, certified by a doctor, he/she must notify the instructor in advance. Unexcused absence from an exam will result in a grade of 0 for that exam.

The dates of the tests and of the mid-term exam can be changed within the first week of class, according with specific exigences of the students.

Tests Four tests will be placed during tutorial sessions. Assigned problems will be based on those solved in class by the TAs. It is strongly recommended that students solve suggested problems at the end of each Chapter.

Test 1: Mon, Jan 31
Test 2: Mon, Feb 14
Test 3: Mon, Mar 28

Mid-term exam Fri, Feb 18

Final exam Wed, April 27, 2pm-5pm, Sport Complex (SCS) E218

Marks

Marks from Tests and Mid-term Exam determine the semester mark S, computed as follows:

Mid-term exam	60%
Tests	40%
Total of semester (S)	100%

This mark will be combined with the Final exam mark F in the following way:

$$0.6F + 0.4S$$

If $F < 55\%$, regardless of the mark of the semester S the overall course grade will be F.

Suggested problems

5th edition

Chapter 5: B-5-2, B-5-5, B-5-8, B-5-20, B-5-21, B-5-23, B-5-27, B-5-28
Chapter 6: B-6-1, B-6-3, B-6-4, B-6-6, B-6-10, B-6-15, B-6-18, B-6-19, B-6-20, B-6-23, B-6-26
Chapter 7: B-7-2, B-7-5, B-7-9, B-7-11, B-7-12, B-7-19, B-7-23, B-7-26, B-7-30, B-7-32, B-7-34

4th edition

Chapter 5: B-5-2, B-5-6, B-5-10, B-5-23, B-5-25, B-5-27, B-5-31, B-5-32
Chapter 6: B-6-1, B-6-4, B-6-6, B-6-9, B-6-14
Chapter 7: B-7-7, B-7-10, B-7-11, B-7-12, B-7-16, B-7-20
Chapter 8: B-8-2, B-8-6, B-8-11, B-8-13, B-8-14, B-8-21, B-8-26, B-8-29
Chapter 9: B-9-2, B-9-5, B-9-9

Tentative lecture schedule

Lecture	Reading	Topic
1: Fr, Jan 7	5-1; 5-2; 5-3 [5-1; 5-2; 5-3]	Course introduction and overview; First and second order systems
2: Tu, Jan 11	5-3 [5-3]	Second order systems
3: Fr, Jan 14	5-4; 5-6 [5-4; 5-6]	Higher order systems; Routh's stability criterion
4: Tu, Jan 18	5-6; 5-7 [5-6; 5-7]	Routh's stability criterion; System performance: effects of integral and derivative control actions
5: Fr, Jan 21	5-7 [5-7]	System performance: effects of integral and derivative control actions
6: Tu, Jan 25	5-8 [5-8]	Steady-state errors in unity-feedback control systems
7: Fr, Jan 28	6-1; 6-2 [6-1; 6-2]	The concept of root-locus; Root-locus plots
8: Tu, Feb 1	6-2 [6-2; 6-3]	Root-locus plots; Gain selection with root-locus plots
9: Fr, Feb 4 6-4; 6-5	[6-5; 7-1; 7-2]	Root-locus plots of positive feedback systems; Control-systems design by the root-locus approach
10: Tu, Feb 8	6-6 [7-3]	Lead compensation
11: Fr, Feb 11	6-7 [7-4]	Lag compensation
12: Tu, Feb 15	6-8; 6-9 [7-5; 7-6]	Lag-lead compensation; Parallel compensation
13: Fr, Feb 18		**Mid-term exam**[1]
Feb 20 - Feb 26		Study week
14: Tu, Mar 1	7-1 [8-1]	(*Solution of the midterm exam*). Systems output to sinusoidal inputs
15: Fr, Mar 4	7-2 [8-2]	Systems output to sinusoidal inputs; Bode diagrams
16: Tu, Mar 8	7-2 [8-2]	Bode diagrams
17: Fr, Mar 11	7-2 [8-2]	Bode diagrams; How to plot Bode diagrams
18: Tu, Mar 15	7-3 [8-4]	Polar plots
19: Fr, Mar 18	7-3; 7-4 [8-4; 8-6]	Polar plots; Log-magnitude-versus-phase plots
20: Tu, Mar 22	7-8 [8-10]	Closed-loop frequency response
21: Fr, Mar 25	7-8 [8-10]	Closed loop frequency response
22: Tu, Mar 29	7-9 [8-11]	Closed-loop frequency response (examples); Experimental determination of transfer functions
23: Fr, Apr 1		Examples and questions
24: Tu, Apr 5		Review of the course
25: Fr, Apr 8		**No class**

[1] The midterm exam will cover topics lectured up to lecture 11 (remind: this is a *tentative* lecture schedule).