Last updated: Wednesday 13 April, 2016

Faculty of Engineering
Department of Mechanical Engineering

CONTROL SYSTEMS
MCG3307A
Davide Spinello
Winter 2016

Course Hours

Monday 14:30 - 16:00
Location: CBY-D207
Type: LEC 1

Thursday 16:00 - 17:30
Location: CBY-D207
Type: LEC 2

Friday 08:00 - 10:00
Location: CBY-B02
Type: TUT 1

Professor

Davide Spinello (dspinell@uottawa.ca)
Phone Number: (613)562-5800 x 2460
Office Hours
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Location: Appointment by email

Teaching Assistant

Farhad Mir Hosseini (fmirh084@uOttawa.ca)
Phone Number: --
Office Hours
-
Location: Appointment by email

Gagandeep Singh (gsing031@uOttawa.ca)
Phone Number: --
Office Hours
Friday 10:00 - 14:00
Location: CBY B08D desk #7

Course Description

Feedback theory. Time and frequency domain analysis of feedback control systems. Stability criteria. Design of simple feedback control systems and compensation techniques. Statespace analysis of

systems. Laboratory experiments.

General and Specific Objectives

This course presents the concepts of transient and steady-state response analysis for control systems, assess the stability of control systems, 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.

Required Material

The textbook in the Section "Monographies" is mandatory. In the course calendar, sections of the book that cover lectures' material are referenced by numbers in square brackets.

Evaluations

Problem Set

Evaluation Date: Ongoing
Evaluation Percentage: 16

The homework assignments are individual and they are instrumental to prepare for exams, as they cover in an advanced way topics addressed in class. There are 4 assignments during the term, each weighting 4% of the final grade.

Written exam (e.g. exam, long answer)

Evaluation Date: Monday 22 February, 2016
Evaluation Percentage: 24

Midterm exam. The exam is in class, open book and open notes. Electronic devices are not allowed. The exam covers the material developed in class up to Lecture 10. For additional information, see the course calendar.

Written exam (e.g. exam, long answer)

Evaluation Date: Saturday 16 April, 2016
Evaluation Percentage: 60

Final exam: MRT 218. The exam is open book and open notes. Electronic devices are not allowed. The exam will may cover all material developed in class.

Course Calendar

Monday 11 January, 2016	**Lecture 1** • Course introduction and overview. • Stability of higher order systems [5-4].
Wednesday 13 January, 2016	**Lecture 2** • Routh's stability criterion [5-6].
Monday 18 January, 2016	**Lecture 3** • Routh's stability criterion [5-6].

Wednesday 20 January, 2016	**Lecture 4** • System performance: effect of derivative and integral control actions [5-7].
Monday 25 January, 2016	**Lecture 5** • Steady-state errors in unity-feedback control systems [5-8].
Wednesday 27 January, 2016	**Lecture 6** • Steady-state errors in unity-feedback control systems [5-8].
Monday 1 February, 2016	**Lecture 7** • The concept of root-locus; root-locus plots [6-1, 6-2].
Thursday 4 February, 2016	**Lecture 8** • Root-locus plots [6-1, 6-2].
Monday 8 February, 2016	**Lecture 9** • Root-locus plots; gain selection with root-locus plots [6-1; 6-2].
Thursday 11 February, 2016	**Lecture 10** • Root-locus plots; gain selection with root-locus plots [6-1; 6-2].
Monday 22 February, 2016	**Lecture 11** • **Midterm exam.**
Thursday 25 February, 2016	**Lecture 12** • Control systems design by the root locus approach [6-5]. • Lead compensation [6-6].
Monday 29 February, 2016	**Lecture 13** • Lag compensation [6-7].
Thursday 3 March, 2016	**Lecture 14** • --
Monday 7 March, 2016	**Lecture 15** • System output to sinusoidal inputs [7-1].
Thursday 10 March, 2016	**Lecture 16** • Bode diagrams [7-2].
Monday 14 March, 2016	**Lecture 17** • Bode diagrams; resonant behaviour [7-2].
Thursday 17 March, 2016	**Lecture 18** • General procedure to plot Bode diagrams; Minimum phase and non-minimum phase systems; Transport lag [7-2].
Monday 21 March, 2016	**Lecture 19** • Experiemental determination of transfer functions [7-9].
Thursday 24 March, 2016	**Lecture 20** • Control system analysis in state-space. State-space representations [9-2].
Thursday 31 March, 2016	**Lecture 21** • Solving time-invariant state equations [9-4]. • Controllability [9-6].
Monday 4 April, 2016	**Lecture 22** • Control systems design in state space. • Pole placement [10-2].
Thursday 7 April, 2016	**Lecture 23** • Quadratic optimal regulator system [10-8].
Monday 11 April, 2016	**Lecture 24** • Observability [9-7]. • State observers [10-5].

Other Information

- At the beginning of the course the students are assumed to be familiar with the theory of ordinary differential equations, Laplace transforms, Fourier transforms, basic complex numbers algebra, and most importantly with material covered in MCG3305 and MCG3306. You are strongly encouraged to review the related material from pre-requisite courses.
- Suggested problems:
    - **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-7-23, B-7-26, B-7-30, B-7-32, B-7-34.
    - **Chapter 9:** B-9-3, B-9-4, B-9-5, B-9-7, B-9-10, B-9-11.
    - **Chapter 10:** B-10-3, B-10-4, B-10-5, B-10-6, B-10-7, B-10-9, B-10-17, B-10-19.

Monographs

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

Plagiarism

Beware of academic fraud!

Academic fraud is an act by a student that may result in a false evaluation (including papers, tests, examinations, etc.). It is not tolerated by the University. Any person found guilty of academic fraud will be subject to severe sanctions.

Here are some examples of academic fraud:

- Plagiarism or cheating of any kind;
- Present research data that has been falsified;
- Submit a work for which you are not the author, in whole or part;
- Submit the same piece of work for more than one course without the written consent of the professors concerned.

Please consult this webpage: it contains regulations and tool to help you avoid plagiarism.
An individual who commits or attempts to commit academic fraud, or who is an accomplice, will be penalized. Here are some examples of possible sanctions:

- Receive an “F” for the work or in the course in question;
- Imposition of additional requirements (from 3 to 30 credits) to the program of study;
- Suspension or expulsion from the Faculty.

You can refer to the regulations on this webpage.

Student Services

Academic Writing Help Centre
At the AWHC you will learn how to identify, correct and ultimately avoid errors in your writing and become an autonomous writer.
In working with our Writing Advisors, you will be able to acquire the abilities, strategies and writing tools that will enable you to:

- Master the written language of your choice
- Expand your critical thinking abilities
- Develop your argumentation skills
- Learn what the expectations are for academic writing

Career Services
Career Services offers various services and a career development program to enable you to recognize and enhance the employability skills you need in today's world of work.

Counselling Service
There are many reasons to take advantage of the Counselling Service. We offer:

- Personal counselling
- Career counselling
- Study skills counselling

Access Service
The Access Service acts as intermediary between students, their faculty and other University offices to ensure that the special needs of these students are addressed and that the best possible learning conditions are being offered.

Note that the University of Ottawa is affiliated with AERO and ACE services for the adaptation of accessible academic materials for students with perceptual disabilities. If you have any questions, please contact the Accessibility Librarian or the Access services for textbooks.