Software Engineering/Mechatronics 3DX4
Dynamic Models and Control of Physical Systems
Jan 2014

INSTRUCTOR:

Dr. Ryan Leduc
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Office Hours: Fridays 14:00-14:50.
Term 2

LECTURES:

- Location: KTH/B135
- Time: Monday, Wednesday, Thursday 17:30-18:20.

  Note: Information will sometimes be sent to your mcmaster.ca e-mail accounts. It's your responsibility to check this account regularly.

LABS: ITB/134. Labs start the week of Jan. 13.

See 3DX4 website for the SE/TRON 3DX4 lab safety manual. You will be tested on the material in the manual before you will be allowed to use the lab equipment.

TEACHING ASSISTANTS: See 3DX4 website for details and contact information.

DESCRIPTION:

Modeling of dynamic continuous physical phenomena in continuous time. Control theory, stability analysis and feedback controller design. Application of computer control to continuous processes. Data analysis, empirical modeling.

MISSION:

To introduce the concepts of process dynamics and control as they apply to physical processes. To develop the necessary mathematical and analysis tools for process control. To understand the interaction between the dynamic behavior of processes and the design of controllers.

GRADING SCHEME:

- Assignments 10%
- Labs 10%

- Midterm 30%
- Final Exam 50%

(The instructor reserves the right to conduct deferred examinations orally. All work on assignments is to be done individually.)

TEXT:

N.S. Nise, *Control Systems Engineering (6th Edition)*, John Wiley & Sons Inc., 2010. ISBN-10: 0470547561.

ADDITIONAL REFERENCES:

- Review previous math courses for linear alegebra (matrices) and Laplace transforms as they will be used heavily in this course.
- Review material in Sfwr Eng 2MX3 about mathematically modelling physical systems.

DETAILED COURSE OUTLINE:

Introduction:

- Process Control Concepts
- Example Control Systems
- Basic Response Characteristics
- Open Loop vs. Closed Loop Control
- Analysis & Design Objectives
- The Design Process

Modeling in the Frequency Domain:

- Review of Laplace Transform
- The Transfer Function
- Obtaining Transfer Functions for specific application domains (e.g. Electrical, Mechanical, Chemical)
- Nonlinearities and Linearization
- Block Diagrams and Their Manipulation

Modeling in the Time Domain:

- State Space Models
- Transfer Function $\Rightarrow$ State Space Model
- State Space Model $\Rightarrow$ Transfer Function

Empirical Model Identification:

Time Response:

- Poles, Zeros and System Response
- First Order Systems
- Second Order Systems
- Higher Order Systems
- Stability
- Steady State Errors

Feedback Control Systems:

- Closed Loop Stability
- PID Controller
- Root Locus Analysis
- Root Locus Controller Design

NOTES:

Academic Dishonesty

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: Grade of F assigned for academic dishonesty), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity. The following illustrates only a few forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not ones own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.
4. Giving a copy of old assignments, midterms, or solutions to other students.
5. Allowing another student to look at or copy your assignment.
6. Using assignment solutions from previous years, other courses, from the internet or the textbook solution manual.
7. Using midterm or exam solutions from previous years that are not given to you by the current instructor.
8. Discussing specifics of how to solve an assignment question with people other than the instructor or the TAs.