Concordia University
Dept. of Computer Science & Software Engineering
Winter 2016

SOEN 385 Control Systems and Applications

- **Textbook:** *Control Systems Engineering, 7th Ed. (2015) by Norman S. Nise, John Wiley & Sons, Inc.*

- **Reference book:** *Feedback Control Systems, by C.L. Phillips and R.D. Harbor , Prentice-Hall*

- **Assignments:** *There will be four assignments. Assignments are due 2 weeks after they are handed out. No late submission will be accepted, Assignments are worth 15% of the final mark.*

- **Mid-term test:** *There will be one mid-term test worth 15% of the final mark.*

- **Project:** *in teams of 3 students, counted for 30% of the final mark. Projects announcement in week 5. Group submissions of two page written proposal in week 7. Final presentations at the end of the term and before the final exam period.*

- **Final exam:** *3-hr final exam at the end of term, worth 40% of the final mark.*

- **Note:** *There is no relationship between the total numerical marks and the final letter grades.*

- **Supporting softwares:** *Matlab, Simulink, Control tollbox and Virtual Reality toolbox.*

What this course is about?

- *Software engineer is an engineering profession.*
- *Engineering involves the study of design and analysis of engineering systems.*
- *Engineering systems are physical systems which could be modeled mathematically (mathematical models).*
- *Many engineering or physical systems are control systems.*

  Examples are: central heating system, auto pilot, robots, automobiles, etc.
- *Software engineers often participate in the development of large softwares for control systems, e.g. software for the control of the space shuttle.*

- The aim of this course is to introduce basic concepts in mathematical modeling, control theory, tools for the design and analysis of control systems, and engineering applications. The emphasis will be on software development.

- More details are in the week-by-week outline.

Week-by-week outline (Tentative schedule)

- ***Week 1. Introduction to control theory: history of control systems (classical and modern control systems), control problems, real-time control systems, system configuration, open-loop vs closed-loop control systems, multivariable control systems, analysis and design objectives, examples and case studies (hard disk drive control system, DC motor speed control system e.g. plotters, insulin delivery control system). Relevance of this course to SOEN curriculum.***

- ***Week 2. Introduction to Matlab programming, Matlab environment. The following toolboxes for control systems design Simulink, Control toolbox, and Virtual Reality will be covered during the course.***

- ***Week 3. Modeling in the frequency domain, Laplace transform, the transfer functions, electrical network transfer functions, translational mechanical system transfer functions, rotational mechanical system transfer functions, transfer functions for systems with gears, electromechanical system transfer functions, electric circuits, nonlinearities and linearization, case studies.***

- ***Week 4. Modeling in the time domain, state space representations and applications, converting transfer function to state space, converting state space to transfer function, case studies.***

- ***Week 5. Time response, poles zeros and system responses, first order systems, second order systems, Laplace transform solutions of state equations, time domain solution of state equations, case studies. (Excluding sections 4.7, 4.8, 4.9)***

- ***Week 6. Reduction of multiple subsystems, block diagrams, analysis and design of feedback systems, signal flow graphs, Mason's rule, signal flow graphs of state equations, similarity transformations, case studies.***

- ***Week 7. Stability, Routh-Hurwitz criterion, stability in state space, case studies.***

- ***Week 8. Steady-state errors: specifications, for unity feedback systems, for disturbances, for nonunity feedback systems, for systems in state space.***
- ***Week 9. Review and midterm exam.***
- ***Week 10. Root locus techniques: properties, sketching, examples.***
- ***Week 11. Design via root locus.***
- ***Week 12. Real time applications.***
- ***Week 13. Project presentations by student groups.***