ENGINEERING 7825: Control Systems II

Instructor Dr. Andrew Vardy
E-mail av@mun.ca
Office Location EN-2018
Office Hours Wednesdays from 1:00 – 3:00
Website http://www.cs.mun.ca/~av/courses/7825-s16

Communication:

- Feel free to drop by my office outside of office hours. If my door is fully closed then I am either absent or busy. Email for an appointment to be sure of catching me.
- Email is the best way of reaching me in general.
- Some materials will be made available on the course website (e.g. notes and assignments) while other materials will only be available through D2L (e.g. solutions). An effort will be made to keep these resources updated, but announcements made in class take priority over electronic communication.

Attendance: Not all of the material presented in class will be available on the website. For example, some derivations, example problems, side-notes, and important discussions may occur in class and yet not be reflected in any materials posted online. Also, announcements and corresponding discussions will occur in class. Thus, to achieve the greatest benefit from the course, class attendance is strongly encouraged.

CALENDAR ENTRY:
ENGI 7825 Control Systems II *examines state space models for multi-input/output systems; observability, controllability; state feedback without and with integral controller structure, state observers; quadratic optimal regulator and tracking control strategies; discrete-time state equations; and an introduction to optimal control.*

CR: the former ENGI 6825
PR: ENGI 5821

Credit Value: 3 Credits; **Accreditation Units**: 36 Combined Educational Hours; focus 100% Engineering Science

Additional Course Information:

The assignments will make use of MATLAB and the Control Systems Toolbox. These components are installed in the faculty's labs but a student version of MATLAB can also be purchased from the Computer Purchasing Centre. The practical assignments will also make use of V-REP a robot simulator which is free for educational use (http://www.coppeliarobotics.com/index.html).

SCHEDULE: Mondays, Wednesdays, and Fridays from 10:00 - 10:50 in EN-1051

TEXT BOOK: None required. Class material will come from some of the books listed below (primarily "Linear State-Space Control Systems").

REFERENCES:

- Williams, R.L., Lawrence, D.A., Linear State-Space Control Systems, Wiley, 2007.
- Chen, C-T., Linear System Theory and Design, Oxford University Press, 1999.
  - This book is available electronically from the library
- Phillips, C.L., Parr, J., Feedback Control Systems, 5th Ed., 2010.
- Franklin, G.F., J.D. Powell, Emami-Naeini, A., Feedback Control of Dynamic Systems, 6th Ed., 2009.
- Ogata, K., Modern Control Engineering, 5th Ed., Prentice Hall, 2010.
- Nise, N.S., Control Systems Engineering, 7th Ed., Wiley, 2015.

MAJOR TOPICS:

- Introduction
- State-Space Fundamentals
- Controllability
- Observability
- Stability
- Design of Linear State Feedback Control Laws
- Observers and Observer-Based Compensators
- Discrete-Time Control
- Introduction to Optimal Control

ASSESSMENT:

		Dates
Assignments	18% (6 @ 3% each)	May 20, June 3, 17, 29, July 15, 29
Practical Assignments	9% (3 @ 3% each)	June 24, July 8, 22
Tests	28% (2 @ 14% each)	June 8, July 20
Final exam	45%	

- The schedule for assignments, practical assignments, and tests will be posted online. Note that this schedule is subject to change. Any changes will be announced in class.
- The assignments will be completed individually, primarily as paper-and-pen exercises with some use of Matlab. The practical assignments will be completed in pairs and utilize Matlab and the V-REP robot simulator.
- Late assignments will only be accepted in case of illness, childbirth, or bereavement, or by prior arrangement with the instructor.
- If you feel any mark was unfair or incorrectly recorded, please inform the instructor before the final exam. Term marks will not be adjusted after the final exam.

LEARNING OUTCOMES:

Upon successful completion of this course, the student will be able to:

#	Learning Outcome	Graduate Attribute .Level of Competence	Assessment Method
1	Understand and explain the advantages of state-space controls over classical	1.3, 7.3	Assignments, tests
2	Formulate the mathematical foundations of state-space methods	2.3	Assignments, tests
3	Identify and apply tests for controllability, observability, stability, and general system time response characterization	2.3, 3.3, 5.3	Assignments, tests
4	Design state-feedback compensators	3.2, 4.3, 5.3	Assignments, tests
5	Design state-feedback compensators with integral control	3.3, 4.3, 5.3	Assignments, tests
6	Design observers and observer-based compensators	3.3, 4.2, 5.3	Assignments, tests
7	Understand and explain the conversions between continuous and discrete control systems	1.3, 2.3, 3.2, 7.3	Assignments, tests
8	Understand and explain the concept of optimal control	1.3, 2.3, 3.2, 4.3	Assignments, tests
9	Implement state-feedback compensation in a discrete system	1.2, 3.2, 4.2, 5.2, 6.3, 7.3, 8.3	Labs

See www.mun.ca/engineering/undergrad/graduateattributes.pdf for more information on the 12 Graduate Attributes you are expected to be proficient in upon graduation.

Each Graduate Attribute for each learning outcome is rated at a level of proficiency between 1 and 3 (1=introductory, 2=intermediate, 3=sophisticated).

LAB SAFETY:

Students are expected to demonstrate awareness of, and personal accountability for, safe laboratory conduct. Appropriate personal protective equipment (PPE) must be worn (e.g. steel-toed shoes, safety glasses, etc.) and safe work practices must be followed as indicated for individual laboratories, materials and equipment. Students will immediately report any concerns regarding safety to the teaching assistant, staff technologist, and professor.

ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at http://www.mun.ca/engineering/undergrad/academicintegrity.php

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at http://www.mun.ca/engineering/undergrad/academicintegrity.php and Memorial University's Code of Student Conduct at http://www.mun.ca/student/conduct/.

INCLUSION AND EQUITY:

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, http://www.mun.ca/blundon/about/index.php. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

STUDENT ASSISTANCE: Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at www.mun.ca/student.