Mechanical Engineering 4R03 – CONTROL SYSTEMS

Instructor: Dr. Saeid Habibi
Office: JHE 307A
Tel: (289) 6740250 ext. 59079 email: habibi@mcmaster.ca

Lectures: Mondays and Thursdays 12:30-1:20 pm
Tuesdays 1:30 - 2:20 pm

Office hours: Thursdays 1:30-2:30 – JHE307A

Room: ITB AB102

Objectives: The purpose of this course is to introduce you to the following: (1) Derivation of mathematical models using ordinary differential equations and Laplace transforms. (2) Analysis of single input/single output systems and their components. This analysis includes a consideration of the system's time response, frequency response and stability characteristics. (3) Design of controllers for single input single output systems that meet design requirements, using root locus and frequency response techniques.

Learning Outcomes: Upon successful completion of the course the student will be expected to have demonstrated the ability to:

1. Be able to describe control systems using accurate terminology
2. Understand the advantages associated with a closed loop control system
3. Model a control system in both the Laplace domain and state space representations.
4. Make reasonable assumptions to simplify a complex control system.
5. Assess the stability of a control system.
6. Assess the steady state errors associated with a particular control system.
7. Design a controller using root locus techniques.
8. Design a controller using frequency response techniques.
9. Be able to make design recommendations that will improve system performance.

Graduate Attributes: This course provides students with an opportunity to develop the following:

Graduate Attributes	Learning Outcomes where it is measured
Knowledge base for Engineering (Indicator 1,3,4)	1,2,3,6,7,8
Problem Analysis (Indicator 2)	2,3,4,5,6
Investigation (Indicator 1,2)	3,4,5,6
Design (Indicator 1,2)	7,8,9

Grades:	Regular Assignments		Not graded, detailed solutions posted on Avenue
	In Class Quizzes	5%	Graded in class – details to be discussed in class
	3 Midterm Tests	45%	Closed book, Crib Sheet - 2 sides of an 8½ x 11 sheet McMaster Standard Calculator allowed Midterm I Details posted on Avenue Midterm II Details posted on Avenue Midterm III Details posted on Avenue
			All MSAF'ed Midterm Grades will be Shifted to Final
	Final Exam	50%	Closed book, Crib Sheet - 2 sides of an 8½ x 11 sheet McMaster Standard Calculator allowed Scheduled by Registrar during exam session.

Lecture Topic	**Text Chapter**	**Comments**
Course Introduction	1	Concepts, Definitions and Examples
Modelling in the Frequency Domain	2	Laplace, Transfer Functions, Nonlinearities
State Space Representations	3	General description and application
Time Response	4	Poles&Zeros, System Response and First and Second Order Systems
Reduction of Multiple Subsystems	5	Block Diagrams and Feedback Systems
Stability	6	Concepts and Routh-Hurwitz Criterion
Steady State Errors	7	With and without feedback, System Type, Specifications, Disturbances
Root Locus Techniques	8	Defining, Properties, Sketching & Refining
Design Via Root Locus	9	Improving Performance
Frequency Response Techniques	10	Bode Plots, Stability, Gain & Phase Margin
Design Via Frequency Response	11	Gain Adjustment, Lead/Lag Compensation
Course Review		

Required Textbook: (Available in the McMaster Bookstore)
N. S. Nise, Control Systems Engineering, 7th Ed. Wiley, Toronto, 2014.
Available via the website: www.wiley.com/college/nise

TA's

Name	Role	Office	Extension	Email
TBA in class				

TA's Office Hours
Professor's Office Hours

POLICY STATEMENT

1. ACADEMIC INTEGRITY:

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 www.mcmaster.ca/academicintegrity.

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's 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.

In this course we will be using email and Avenue. Students should be aware that when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

2. DISCRIMINATION:

THE FACULTY OF ENGINEERING IS CONCERNED WITH ENSURING AN ENVIRONMENT THAT IS FREE OF ALL ADVERSE DISCRIMINATION. IF THERE IS A PROBLEM THAT CANNOT BE RESOLVED BY DISCUSSION AMONG THE PERSONS CONCERNED, INDIVIDUALS ARE REMINDED THAT THEY SHOULD CONTACT THEIR DEPARTMENT CHAIR, THE SEXUAL HARASSMENT OFFICE OR THE HUMAN RIGHTS CONSULTANT, AS SOON AS POSSIBLE.