EENG307: Introduction to Feedback Control Systems

Dr. Christopher Coulston

Semester/Year: Spring 2026

1 Syllabus

Course Info

- Course Webpages: Canvas (http://elearning.mines.edu/). All current CSM students should have a Canvas account, and students registered for this course will be automatically enrolled. Check with CCIT if you do not have an account. Canvas will be used to post homework assignments, submit homework assignments, view grades, and other section-specific material.

Instructor

- Section A - MWF 12:00 - 12:50 in W280 Brown
  - Instructor: Christopher Coulston
  - Office: BB314E
  - Office hours: MWF 1:30 - 3:00
  - Email: coulston@mines.edu

Instructional Activity: 3 hours lecture, 0 hours lab, 3 semester hours.

Course description from the Bulletin:

> System modeling through an energy flow approach is presented, with examples from linear electrical, mechanical, fluid and/or thermal systems. Analysis of system response in both the time domain and frequency domain is discussed in detail. Feedback control design techniques, including PID, are analyzed using both analytical and computational methods.

The Textbook (Optional)

Gene F. Franklin, J. David Powell, Abbas Emami-Naeini, *Feedback Control of Dynamic Systems*, 7th Edition. ISBN 0133496597.

Objectives

Students will be able to:

- Develop mathematical models for linear dynamic systems (mechanical, electrical, fluid, and/or thermal).
- Use time domain and frequency domain tools to analyze and predict the behavior of linear systems.
- Use time domain and frequency domain techniques to design feedback compensators to achieve a specified performance criterion.
- Use MATLAB for system analysis and design.

Letter Grades

Letter grades will be assigned as stipulated in the undergraduate bulletin http://bulletin.mines.edu/undergraduate/undergraduateinformation/undergraduategradingsystem/

- A $\geq$ 93
- 93 $>$ A- $\geq$ 90
- 90 $>$ B+ $\geq$ 87
- 87 $>$ B $\geq$ 83
- 83 $>$ B- $\geq$ 80
- 80 $>$ C+ $\geq$ 77
- 77 $>$ C $\geq$ 73
- 73 $>$ C- $\geq$ 70
- 70 $>$ D+ $\geq$ 67
- 67 $>$ D $\geq$ 63
- 63 $>$ D- $\geq$ 60
- 60 $>$ F

Grading Scale

Available Points

Exam 1	Prep Score	12%
	Exam Score	21%
Exam 2	Prep Score	12%
	Exam Score	21%
Exam 3	Prep Score	12%
	Exam Score	22%
Total		100 %

Prep Score

The course is split into three intervals, each one associated with an exam. During each interval there will be

- 4 Homework Assignments - 10 points each
- 2 Canvas Quizzes - 10 points each

Each prep score is out of 40 points, which includes the best 4 of the 6 scores from the group of homework and Canvas quizzes. The exception to this policy is Homework #12 whoses score cannot be droppped - you must complete this homework.

Homework

- Homework is assigned weekly.
- At least partial credit is given for each problem with a legitimate attempt. Problems may be graded unequally.
- Homework is due at 11:59pm on the due date.
- Homework must be turned in on Canvas/Gradescope. It must be submitted as a **single** .pdf file, readable, with **all pages right side up**. Files that are not submitted correctly will not be graded.
- **No late homework is accepted for any reason**.

Exams

- Mid-term exams: There will be three in class exams during the semester, with dates given in the schedule below. Note these dates and plan accordingly!
- No calculators are allowed in the exams. Graphs of important functions will be provided, but you will need to be able to do simple arithmetic by hand. You may not use your phone during exams. However, slide rules are allowed!

Absenteeism

- Sports/Activities Policy
  - Alternate scheduling will be made available for exams.
  - Let your instructor know at least a week prior and they will work with you to make accommodations.
  - No extension for Canvas quizzes.
- Sickness/Life Issues
  - If you are ill, pleased do not attend class, labs, or exams.
  - Complete the "Request an Excused Absence" form on the Mines website.
  - If you are going to miss an exam, email your professor ASAP to make alternate arrangements.

Academic Honesty

The Colorado School of Mines affirms the principle that all individuals associated with the Mines academic community have a responsibility for establishing, maintaining and fostering an understanding and appreciation for academic integrity. In broad terms, this implies protecting the environment of mutual trust within which scholarly exchange occurs, supporting the ability of the faculty to fairly and effectively evaluate every student's academic achievements, and giving credence to the university's educational mission, its scholarly objectives and the substance of the degrees it awards. The protection of academic integrity requires there to be clear and consistent standards, as well as confrontation and sanctions when individuals violate those standards. The Colorado School of Mines desires an environment free of any and all forms of academic misconduct and expects students to act with integrity at all times.

Academic misconduct is the intentional act of fraud, in which an individual seeks to claim credit for the work and efforts of another without authorization, or uses unauthorized materials or fabricated information in any academic exercise. Student Academic Misconduct arises when a student violates the principle of academic integrity. Such behavior erodes mutual trust, distorts the fair evaluation of academic achievements, violates the ethical code of behavior upon which education and scholarship rest, and undermines the credibility of the university. Because of the serious institutional and individual ramifications, student misconduct arising from violations of academic integrity is not tolerated at Mines. If a student is found to have engaged in such misconduct sanctions such as change of a grade, loss of institutional privileges, or academic suspension or dismissal may be imposed.

For this course, the following rules should be followed:

- All students must turn in individual homework (unless otherwise stated) and they must understand what they turn in.
- Copying of solutions without understanding them is not allowed; if a student copies a solution and cannot explain it adequately this is considered academic dishonesty.
- For computer exercises, each student is expected to generate his/her own solution (i.e. one cannot simply copy another person's computer solution and modify it slightly to make it look like it is your own work).
- During exams students must do 100 percent of the work on their own.
- The nominal penalty for academic dishonesty is an 'F' in the course.

MATLAB

- A tool for technical computing with a programming like interface. (You should have already taken Fortran, C, or Java.)
- Easy access to highly optimized numerical methods.
- You are responsible for becoming familiar with the MATLAB interface. If you are unfamiliar with MATLAB, we would recommend purchasing an introductory text, or make use of the myriad tutorials on the internet.
- You will also find some introductory information about MATLAB in your textbook at the end of most chapters and in the appendix.
- Instructions for accessing MATLAB from your laptop (called remote access) can be found here: http://inside.mines.edu/Matlab.

2 Resources

Resources

There are numerous resources available to help you learn the course material. They include:

- Lectures (in class)
- Electronic lecture files (available on Canvas), with self quizzes at the end of each lecture
- Homework problems and solutions (posted on Canvas)
- Your professors (office hours, email)
- We have teaching assistant(s) who will be holding office hours. Times and locations to be announced.
- Students are encouraged to seek academic support if struggling with course material. Information on Tutoring, Academic Excellence Workshops, and Academic Coaching can be found at http://academicservices.mines.edu.

Disability Support Statement:

The Colorado School of Mines is committed to ensuring the full participation of all students in its programs, including students with disabilities. If you are registered with Disability Support Services (DSS) and I have received your letter of accommodations, please contact me at your earliest convenience so we can discuss your needs in this course. For questions or other inquiries regarding disabilities, I encourage you to visit http://disabilities.mines.edu for more information.

3 Schedule

(Note: this schedule is subject to change)

Date	Topic	Lec.	Assignments
Mon, January 12	Course Introduction	1	
Wed, January 14	Modeling Mechanical Systems	2	
Fri, January 16	Laplace Transform Review	3	
Mon, January 19	**Martin Luther King Day - No Class**		
Wed, January 21	Solving Differential Equations using Laplace Transforms, Part I	4	Homework #1 Due
Fri, January 23	Solving Differential Equations using Laplace Transforms, Part II	5	
Mon, January 26	Impedance and Transfer Functions	6	
Wed, January 28	Translational Mechanical Impedance	7	Homework #2 Due
Fri, January 30	Block Diagrams	8	
Mon, February 2	Application Example I - Car Parking	9	
Wed, February 4	**Career Fair**		
Fri, February 6	Fluid Systems and System Analogies	10	Homework #3 Due
Mon, February 9	Rotational Mechanical Impedance	11	
Wed, February 11	Modeling DC Motors	12	
Fri, February 13	Time Response of First Order Systems	13	
Mon, February 16	**Presidents Day - No Class**		
Wed, February 18	Exam Review		Homework #4 Due HW Makeup Quizzes
Fri, February 20	**Exam I**		
Mon, February 23	Time Response of Second Order Systems	14	
Wed, February 25	Time Response of Higher Order Systems	15	Homework #5 Due
Fri, February 27	System Identification	16	
Mon, March 2	Stability and Routh Hurwitz Criterion	17	
Wed, March 4	Disturbances and Steady State Error	18	Homework #6 Due
Fri, March 6	References, Steady State Error, and System Type	19	
Mon, March 9	Introduction to Root Locus	20	Homework #7 Due
Wed, March 11	Root Locus Examples	21	
Fri, March 13	PD Design Using Root Locus	22	
Mon, March 16	Exam II Review		Homework #8 Due HW Makeup Quizzes
Wed, March 18	**Exam II**		
Fri, March 20	Makeup day		
Mon, March 23	**Spring Break**		

Date	Topic	Lec.	Assignments
Mon, March 30	Sinusoidal Steady State	23	
Wed, April 1	Bode Plots for First Order Systems	24	
Fri, April 3	Bode Plots for Second Order Systems	25	
Mon, April 6	Bode Plots for Higher Order Systems	26	Homework #9 Due
Wed, April 8	Bode Plot Examples	27	
Fri, April 10	Application Example IV - Electronic Filters	28	
Mon, April 13	Nyquist Stability Theorem	29	
Wed, April 15	Nyquist Stability Analysis	30	Homework #10 Due
Fri, April 17	**E Days**		
Mon, April 20	Gain and Phase Margin	31	
Wed, April 22	Systems with Time Delay	32	
Fri, April 24	Designing Controllers Using Bode Plots, Part 1	33	Homework #11 Due
Mon, April 27	Designing Controllers Using Bode Plots, Part 2	34	
Wed, April 29	PID Control Application I	35	
Fri, May 1	PID Control Application II	36	
Mon, May 4	Review for exam		
Wed, May 6	Makeup day		HW12 Due HW Makeup Quizzes
Wed, May 13	Final Exam at 10:15		