

Control of Mechanical Engineering Systems EML 4312 – Fall 2020

Instructor: Warren E. Dixon

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Teaching Assistants:

(TA) Ciku Wanjiku

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(TA) Emily Griffis

Room 310 MAE-B

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*Questions related to grading should first be directed to a TA, and if the question is not sufficiently resolved, then you are more than welcome to discuss grading issues with Prof. Dixon.

Class Home page: Canvas

Office Hours:

Dixon: T 9:00-10:00 AM or by appointment.

<https://ufl.zoom.us/j/97592673338?pwd=RWY3SDdkTk51Rnc4N0FwZWVvTWVvZz09>

Ciku: T 10:00AM-11:00 AM or by appointment.

<https://ufl.zoom.us/j/91504837017?pwd=UEo1eXkyd3lyNkZzQjlhVTBqL2FWUT09>

Emily: F 9:35-10:35 Am or by appointment.

<https://ufl.zoom.us/j/96725659987>

Meeting Times, Due Dates, and Zoom:

- Class: MWF 1:55-2:45 PM (7th period). The course will be taught on-line only in a synchronous manner where students can participate and ask questions (which will be recorded with implied consent). The course recording will also be posted on the canvas page for asynchronous viewing. The zoom link for the course is

<https://ufl.zoom.us/j/94227859907?pwd=amkvVmJlVnNCMTlXKzdQWGHnbWQwQT09>

- Exam dates are the following: **Exam 1 (Sept 23), Exam 2 (Oct 21), Exam 3 (November 23)**. Exams will be available during a specific window of time via canvas on the listed test day, students will have 1 hour to complete the test, scan it into a pdf and upload it to canvas.
- Quiz dates: A short (1-2 question) quiz will be assigned for graded completion prior to each class meeting. Quizzes will be timed, canvas-based quizzes.
- The Final Exam will be 12/16/2020 @ 3:00 PM - 5:00 PM (per the Registrar calendar).

Suggested Textbook: *Modern Control Systems* by Richard C. Dorf and Robert H. Bishop, Prentice Hall. Any edition of the book is sufficient.

This book has a very useful companion web site at www.prenhall.com/dorf that has useful practice/review problems.

Required Software: MATLAB. The version of Matlab in the UF APP store for students includes sufficient toolboxes for class simulations.

Course Prerequisites: MAP 2302, EGM 3400 or EGM 3401.

Catalog Description: Theory, analysis, and design of controls of mechanical engineering systems; including mechanical, electromechanical hydraulic, pneumatic and thermal components and subsystems.

Course Purpose: The goal of EML 4312 is for you to acquire skills to model simple engineering systems, apply time and frequency domain analysis techniques, and design control systems to achieve specific dynamic characteristics. Emphasis will be placed on understanding the concepts behind classical and modern control techniques, and applying these techniques using the MATLAB programming environment.

Contribution of Course Towards Professional Goals: This course contributes to enhancing the student's knowledge of advanced mathematics through multivariable calculus, differential equations, and linear algebra. This course also contributes to the student's ability to work professionally in mechanical and aerospace systems areas including design and analysis of such systems.

Relationship of Course to Program Outcomes: This course will provide the student with the ability to:

- (Program Outcome 1) identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (strongly supported)
- (Program Outcome 2) apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (minimally supported)
- (Program Outcome 7) acquire and apply new knowledge as needed, using appropriate learning strategies (minimally supported)

Course Objectives: By the end of this course, you should be able to do the following:

- Write differential equations describing the behavior of engineering systems.
- Use the Laplace transform to describe the transfer function of engineering systems and determine the time domain response to a wide range of inputs.
- Use state-variable equations to model engineering systems and determine their time response to a wide range of inputs.
- Describe the advantages of feedback control.
- Analyze the performance of control systems.
- Determine the stability of control systems using Routh-Hurwitz, Root-Locus, Bode, and Nyquist methods.
- Design feedback control systems using frequency domain and state-variable methods.

Course Outline: To meet the above objectives, the class lectures will approximately adhere to the following outline.

- **Introduction** (1 lecture)
- **Modeling Physical Systems and Mathematics** (8 lectures) – includes Laplace transform, development and solution of differential equations, partial fraction expansion, inverse Laplace transform, stability, time response, block diagram construction and reduction
- **Frequency Domain Analysis and Design** (20 lectures) – includes root locus, magnitude and angle condition, time response characteristics, steady state error, lead/lag compensation, Bode plots
- **State-Space Analysis** (6 lectures) – State-space equations, matrix review, Eigenvalues, Eigenvectors, state transition matrix, state space solutions
- **State-Space Design** (5 lectures) – Pole placement design, Ackerman's Formula, state space observers, state space regulators

Policies and Procedures:

- **Zoom.** Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

- **Homework.** Problems will be assigned as homework on a regular basis but not collected for a grade. Solutions will be provided after a delay to allow students to complete the problems on their own. You are also strongly encouraged to work through the problem sets for the relevant chapters of Dorf on-line at www.prenhall.com/dorf. Homework questions are representative of the level of knowledge that will be tested.
- **Quizzes.** After each class period a canvas-based quiz will be available until the beginning of the next class period. Quiz questions will mainly cover material from the preceding class period. Each quiz is timed, and must be completed within the time limit. Quizzes are intended to be individual efforts and any form of collaboration or sharing answers is considered cheating. They are open-book open-note, but timing will make it difficult for you to look up extensive material during the quiz. Quizzes will be easier questions than the test material and are mainly intended to make sure that students are following the course pace.
- **Exams.** Exams will be **CLOSED-BOOK, CLOSED NOTE** and **ANY ASSISTANCE** from **ANY SOURCE** is considered a violation of the honor code. If you do not agree with the grading of a particular exam problem, you will have one week from the date the exam is returned to submit a written explanation of why you think the grade should be higher to the TAs. All grading discussions should be done with the course TAs first and then with the course instructor if an acceptable resolution is not made with the TA. However, the final decision will remain the instructor's.
- **Grading.** The final course grade will be calculated based on the following percentages: Combined Quizzes 10%, Exams 60% (20% each), and Final Exam 30%.
- *Exam grades and final grades will not be curved.* It is possible for every student in the class to receive an A (or an E). Your grade will depend only on your performance and not on that of others in the class. It is therefore in your best interest to work with others on the homework assignments to improve your understanding of the material. Please note, however, that all work on the exams must be completed individually, and that no communication whatsoever is permitted with others during the exams.
- The grading scale is as follows.

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

- **Make-up Exam Policy:** No make-up exams will be given unless prior approval by the instructor is obtained by the student.
- **Late Exam Policy:** Given the windows of time required to upload the exam, late uploading due to any reason will not be accepted. Failure to upload a test in the appropriate window of time will result in those questions not being graded and given zero credit.

- **Honesty Policy:** All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.
- **Students Requiring Accommodations:** Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.
- **Course Evaluation:** Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.
- **Software Use:** All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.
- **Student Privacy:** There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>
- **Campus Resources:**

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.

<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.

<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.

<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.