

Process Control Theory
ECH 4323 Section CEL5 (Class Number 25575)
Class Periods: MWF, Period 8 (3:00 - 3:50 PM)
Location: Little 121
Academic Term: Spring 2023

Instructor: Spyros A. Svoronos

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E-mail: svoronos@ufl.edu

E-mails must include a call-back phone number.

Without it, they may not receive a response.

Office Hours : T 4:30-6:00 pm via Zoom

W 4:30-6:00 pm in my office (masks are optional but encouraged)

F 4:30-6:00 pm via Zoom

Zoom: <https://ufl.zoom.us/j/6379945549> with passcode: 0

Teaching Assistant: None

Course Description

The analysis and automatic control of process systems in chemical engineering.

Course Pre-Requisites / Co-Requisites

Prerequisites: COT 3502 and* ECH 3023 and* MAP 2302 (*Catalog incorrectly has 'or')

Corequisite: ECH 4323L

Course Objectives

1. The student will be able to formulate dynamic models for chemical engineering systems and to perform model-linearization procedures
2. The student will be able to obtain approximate process models from experimental data
3. The student will be able to use and tune proportional-integral-derivative controllers
4. The student will be able to analyze the performance and stability of linear control systems, both open loop and closed loop

Materials and Supply Fees: None

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare,	High

as well as global, cultural, social, environmental, and economic factors	
3. An ability to communicate effectively with a range of audiences	
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

Required Textbook: None. Instructor notes are posted in CANVAS.

Spring 2021 Videos: https://uflorida-my.sharepoint.com/:f:/g/personal/svoronos_ufl_edu/EtBnr53oz3NLqICy4xVmqEgBKKI3I_IEbLdH99V2hRfa7g?e=IAY0Ye

[my.sharepoint.com/:f:/g/personal/svoronos_ufl_edu/EtBnr53oz3NLqICy4xVmqEgBKKI3I_IEbLdH99V2hRfa7g?e=IAY0Ye](https://uflorida-my.sharepoint.com/:f:/g/personal/svoronos_ufl_edu/EtBnr53oz3NLqICy4xVmqEgBKKI3I_IEbLdH99V2hRfa7g?e=IAY0Ye)

Computer: Laptop computer **running Windows, Excel, and Python** is required. Additional frequency response software is provided by the instructor without charge.

Course Topics (The timing is approximate as I slow down or accelerate according to my perception of how well the students comprehend what I am lecturing on).

- Introduction to feedback and feedforward control (1st week)
- Nonlinear state space models and their linearization (weeks 2-4)
- Laplace transforms, transfer functions, and open-loop stability (weeks 5-6)
- First-order plus time delay systems and approximate transfer functions from experimental data (weeks 7-8)
- The PID control law and low-pass filtering (week 8)
- Controller tuning methods for first order plus time delay systems (weeks 8-9)
- Velocity and position forms of the discrete PID control law (week 9)
- Frequency response analysis (weeks 10-11)
- Closed-loop stability analysis (weeks 12-13)
- Controller tuning methods for any transfer function model (week 14)

Attendance Policy

Class attendance or attendance of the first Zoom office hour after a missed class is required. I recognize that infectious diseases may force some students to miss class for long periods of time. I am therefore providing access to recordings of the spring 21 offering of the class and accompanying PowerPoint slides, and I intend to follow the same topic coverage. In other

words, if you miss a class but watch and understand the corresponding spring 21 video you should be ok. If able, during the missed class you should watch the corresponding video, and then join the first office hour after the missed class. Continual absences without office hour visits will significantly impact the class attendance and participation grade which makes up 5% of your total grade (see below).

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Course Assessment

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| - Exam 1, Thursday March 9, 4:05-? PM (maybe via HonorLock) | 37.5% |
| A review will be held Tuesday March 7, 5:30-9:30 PM | |
| - Exam 2, Wednesday May 3 12:30 PM -? (maybe via HonorLock) | 37.5% |
| A review will be held Thursday April 27, 3:00-7:00 PM | |
| - Classwork and Homework | 20% |
| Each homework/classwork problem (or part of it) will be graded in a scale from 0 to 3, with a 3 earned only for perfect answers. | |
| - Class attendance & participation | 5%. |

Detailed Explanation of Grading

1. For each student, Overall Points are calculated as follows:

$$\text{Overall Points} = 0.375 * \text{Exam1 Grade} + 0.375 * \text{Exam2 Grade} + 0.20 * \text{Homework/Classwork Grade} + 0.05 * \text{Class Participation Grade}$$

where

- Exam grades are 0-100
- Homework/Classwork Grade = (Total homework points earned)/(maximum possible points) *100
- Class participation grade:
88 if student never misses class (without excuse) and never speaks. This number is multiplied by the fraction of times the student was present in class. Then the grade is raised according to how frequently a student answers or asks questions. Corrections of my lecture errors are especially noted.

2. The students are sorted in the order of decreasing overall points. Grades are then decided as follows:

Division between A and A- : Largest gap between two students with $90 \geq \text{overall points} > 85$

Division between A- and B+ : Largest gap between two students with $85 \geq$ overall points > 80

Division between B+ and B : Largest gap between two students with $80 \geq$ overall points > 75

Division between B and B- : Largest gap between two students with $70 \geq$ overall points > 65

Division between B- and C+ : Largest gap between two students with $65 \geq$ overall points > 60

Division between C+ and C : Largest gap between two students with $60 \geq$ overall points > 55

Division between C and C- : overall points ≥ 50 (no gap here, 50 is C, 49.9 C-)

Division between C- and D+ : Largest gap between two students with $40 \geq$ overall points > 35

Division between D+ and D : Largest gap between two students with $30 \geq$ overall points > 25

Division between D and D- : Largest gap between two students with $5 \geq$ overall points ≥ 0

(never happens)

E: Pursued for students with honesty violations

The class participation grade is designed so that a student who attends class regularly will not have an A grade lowered even if s/he never speaks. It helps attending students with lower overall points.

ADDITIONAL INFORMATION

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student

who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Conduct Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

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: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

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

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

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://career.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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>;<https://care.dso.ufl.edu>.

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