EML 6934 - Optimal Control
Spring 2022

COURSE INSTRUCTOR

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YouTube Channel: https://www.youtube.com/user/anilrao2

All contact methods are acceptable! Note for fastest response it is best to reach me on my mobile phone.

COURSE LOCATIONS AND CLASS PERIODS

Class Period: MWF 5:55 — 2:45 PM (Period 7). Attendance is expected.
Lecture Room: MB 102
Online Videos: Class will be recorded via UF EDGE
Office Hours: As Needed MWF 3:00 PM to 4:00 PM
Office Hours Zoom Link:
- Meeting ID: 923 1814 1900
- Click here for Zoom link or copy and paste the following URL into your browser: https://ufl.zoom.us/j/92318141900.

CATALOG DESCRIPTION

Calculus of variations, calculus of variations applied to optimal control, nonlinear optimization, numerical Methods for optimal control

PREREQUISITES

Differential and integral calculus, ordinary and partial differential equations

COURSE OBJECTIVES

- Develop the fundamentals of calculus of variations
- Develop fundamentals of optimal control theory using calculus of variations
- Introduce major numerical methods for solving constrained optimal control problems

IMPORTANT NOTE

I consider it an honor and a privilege to be able to teach all of you, and I intend to provide the best instruction possible in order to enable you to learn the material well. If you cannot make office hours, please contact me and we will set up a time for you to get help. Regardless of how busy I am with other things, I will do what I am able to make myself available.

APPROXIMATE SCHEDULE FOR MATERIAL

Topic	Material Covered	Schedule
Review of Minima and Maxima of Functions	Optimization of Function of One Variable	Week 1
Calculus of Variations	Develop Theory of Calculus of Variations	Weeks 2 and 3
Calculus of Variations Applied to Optimal Control Problems	Optimality Conditions, Linear Quadratic Control, Pontryagin's Minimum Principle, Bang — Bang Optimal Control, Singular Arcs	Weeks 4 through 8
Nonlinear Optimization		Week 9
Numerical Methods for Optimal Control	Unconstrained and Constrained Finite-Dimensional Optimization	Week 10 through 13
	Indirect Methods and Direct Methods	

OFFICE HOURS

Note: if for some reason you are unable to make my office hours, you can always schedule an appointment at a time that is mutually agreeable to both you and I.

OFFICE HOURS

Name	Times	Meeting Location and Contact
Anil V. Rao (Instructor)	MWF 3:00 PM to 4:00 PM	Zoom: https://ufl.zoom.us/j/92318141900 (Meeting ID: 923 1814 1900) anilrao@ufl.edu

PERSONAL HOURS

I have found that often students want to talk with me about topics other than the course. Sometimes it is just to get career directions and advice, other times to find out about opportunities to work in my research group as an undergraduate or graduate student. Because students would like to have conversations on such topics (and other topics), each week I will hold what I call "personal hours". If you are interested in just having a conversation with me that is not specific to the course material, please join me for personal hours. I will try to make these hours actual in-person hours because I feel it is the best way to have non-technical conversations. As a result, I will hold personal hours in the Reitz Union food court.

Personal Office Hours Times	Meeting Location
Friday 4:00 PM to 5:00 PM	Reitz Union Food Court (Next to Starbucks)

Note: I am happy to schedule other times for personal meetings about topics not related to the course. Please feel free to ask.

TEXTBOOK

Kirk, D. E., *Optimal Control Theory: An Introduction*, Dover Publications, 1970.

HOMEWORK ASSIGNMENTS

All homework in this class is optional. Nothing is graded, but I am happy to discuss and go over any and all problems on the assignments.

Assignment
Homework #1
Homework #2
Homework #3
Homework #4
Homework #5

ATTENDANCE RULES

Regular attendance is expected of all students.

CHEATING

Cheating of any kind in this course will be enforced in accordance with the university rules. Any violation of any kind (even something as simple as a single line of code that is identical in the homework of two students) will automatically result in an "E" in the course and will reported as appropriate to the Dean of Students Office.

MAKE-UP POLICY

Because all assignments in this course are not time limited (in the same manner as that a usual in-class exam), make-ups will be provided on a case-by-case basis. If you have an issue (illness, other urgent matter), please discuss it with me and we will work to find a fair and reasonable solution.

COURSE GRADING

Item	Point Value
Homework Assignments	0
Midterm Exam	50
Project	50
Total	100 Points

GRADING SCALE

Grades in this course are determined using the following scale:

Letter Grade	Score Range
A	95 and Above
A-	90 to less than 95
B+	85 to less than 90
B	80 to less than 85
B-	75 to less than 80
C+	70 to less than 75
C	65 to less than 70
C-	60 to less than 65
D+	55 to less than 60
D	50 to less than 55
D-	45 to less than 50
E	Less Than 45

NOTES ON ASSIGNMENT OF FINAL LETTER GRADES

- The grading scale posted above is not flexible.
- Any score on the boundary between two ranges will receive the higher grade (for example, a 94 receives a grade of "A-").
- Finally, it is noted that while your individual scores for assignments, exams, and quizzes will be posted on E-learning (Canvas), the Canvas portal may not accurately reflect a student's relative standing in the class. Regardless of the information that is seen in Canvas, computation of final grades will be based on the criteria set forth above and a student's grade will only be final when grades have been computed at the end of the semester.

IMPORTANT NOTE: Any assignment either not submitted or not completed with a good faith effort (where the judgment of "good faith effort" rests wholly with me) will result in a full letter grade deduction in the course. For example, if the final score falls into the category of an "A-" and one homework or quiz is not submitted or is deemed to not have been performed with a good faith effort, the final grade will be a "B-". This policy is not flexible.

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.

COVID — 19

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and Schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are quarantined from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the UF Health Screen, Test & Protect website for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

COURSE EVALUATIONS

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.