

Course Syllabus

CONTROL OF BIOLOGICAL SYSTEMS

EEL 5xxx Section 1234

Class Periods: MWF 8 (3pm-3:50pm)

Location: Classroom location

Academic Term: Spring 2023

Instructor:

Name: Jacob Hammer

Email Address: hammer@mst.ufl.edu

Office Phone Number: 3523924934

Office Hours: MWF hours available, office location

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact through the Canvas website

- Name, email address, office location, office hours
- Name, email address, office location, office hours

Course Description

The automatic control principles that govern critical processes in human biology are explored. Through the development of mathematical models of biological systems, the course creates an understanding of metabolic, immunologic, and genetic processes. Applications include the manufacture of vaccines, monoclonal antibodies, cancer treatments, insulin, and many others.

Course Pre-Requisites

- A basic knowledge of biology & Basic knowledge of control systems
- Or instructor consent

Course Objectives

Introduce students to general principles of mathematical modeling and automatic control, as they apply to natural processes in human biology and to the production of biologicals -- medicines such as RNA vaccines, insulin, and others.

Materials and Supply Fees

N/A

Required Textbooks and Software:

- "Biomolecular Feedback Systems", Domitilla Del Vecchio and Richard M. Murray, Princeton University Press, Princeton, NJ, USA, 2014, ISBN 9780691161532
- Instructor course notes
- Access to Matlab or equivalent scientific computation software

Recommended Materials: None

Course Schedule

Week 1: Introduction: basic notions in biological systems.

Week 2: Principles of mathematical modeling of biological systems (homework 1; due one week after assignment)

Week 3: Mathematical modeling of gene transcription (homework 2; due one week after assignment)

Week 4: Mathematical modeling of the process of translation (homework 3; due one week after assignment)

Week 5: Mathematical modeling of transcription regulation (homework 4; due one week after assignment)

Week 6: Dynamical behavior of nonlinear systems with applications to biological systems (homework 5; due one week after assignment)

Week 7: Equilibrium of nonlinear systems

Week 8: The notion of robustness in biological systems (midterm exam)

Midterm exam: covers material of homeworks 1-5 and class material of weeks 1-6.

Week 9: Oscillations in biological systems

Week 10: Model reduction: reducing the dimension of mathematical models in biology (homework 6; due one week after assignment)

Week 11: Uncertainty and stochastic behavior (homework 7; due one week after assignment)

Week 12: Interconnecting biological systems

Week 13: Retroactivity in biological systems (homework 8; due one week after assignment)

Week 14: Buffering and insulating devices (homework 9; due one week after assignment)

Week 15: Review

Final exam: comprehensive

Attendance Policy, Class Expectations, and Make-Up Policy

Excused absences must be consistent with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulations>) and require appropriate documentation.

Additional information can be found

here:<https://gradcatalog.ufl.edu/graduate/regulations/>

Late submission policy:

There is no penalty for late submissions that received prior approval by instructor.

Without prior approval by instructor, a penalty of 50% will be assessed to the assignment.

Evaluation of Grades

****NOTE:** Course evaluation components should include:

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
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Homework	100	10%
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Midterm Exam	100	35%
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Final Exam 100 55%
100%

Homework assignments consist of problems involving the derivation of mathematical models of biological systems, the analysis of such models, and the application of control theoretic principles to investigate the stability of such models.

Grading Policy

Differences in grading rubrics: this course is taught concurrently with an undergraduate course of the same name, EEL 4xxx. Students in the graduate course must complete all assignments and exams, while students in the undergraduate course are allowed to skip one question of each homework assignment and one question of each examination. In addition, grades of the graduate course are curved independently of the grades of the undergraduate course.

Percent	Grade	Grade Points
93%- 100%	A	4.00
90% - 92%	A-	3.67
87% - 89 %	B+	3.33
83% - 86%	B	3.00
80% - 82%	B-	2.67
77% - 79%	C+	2.33
73% - 76%	C	2.00
70% - 72%	C-	1.67
67% - 69%	D+	1.33
63% - 66%	D	1.00
60% - 62%	D-	0.67
0% - 59%	E	0.00

More information on UF grading policy may be found at:
<https://catalog.ufl.edu/graduate/regulations/>

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.a.a.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

Covid-19 Protocols:

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated. Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.
- 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. 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.

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>.

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CONTROL OF BIOLOGICAL SYSTEMS

EEL 4xxx Section XXXX

Class Periods: MWF 8 (3pm-3:50pm)

Location: Classroom location

Academic Term: XXXX

Instructor:

Name: Jacob Hammer

Email Address: hammer@mst.ufl.edu

Office Phone Number: 3523924934

Office Hours: Days of week, hours available, office location MWF 3:50-4:40PM

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

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- Name, email address, office location, office hours
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Course Description

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Course Pre-Requisites

- A basic knowledge of biology (BSC 2005 or AP biology, or equivalent) w/ "C" or better &
- Basic knowledge of control systems (EEL 4657C or EEL 4610 or EEL 3135 or equivalent) w/ "C" or better
- Or instructor consent

Course Objectives

Introduce students to general principles of mathematical modeling and automatic control, as they apply to natural processes in human biology and to the production of biologicals -- medicines such as RNA vaccines, insulin, and others..

Materials and Supply Fees

N/A

Professional Component (ABET):

This course consists of 1.5 credits of Basic Science and 1.5 credits of Engineering Science

Relation to Program Outcomes (ABET):

The table below is an example. Please consult with your department's ABET coordinator when filling this out.

Outcome Coverage*

1. an ability to apply knowledge of mathematics, science, and engineering. Medium
2. an ability to function on multi-disciplinary teams High
3. the broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context Medium
4. An ability to communicate effectively with a range of audiences Medium

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks and Software :

- "Biomolecular Feedback Systems", Domitilla Del Vecchio and Richard M. Murray, Princeton University Press, Princeton, NJ, USA, 2014, ISBN 9780691161532
- Instructor course notes
- Access to Matlab or equivalent scientific computation software

Recommended Materials: None

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Week 14: Buffering and insulating devices (homework 9; due one week after assignment)

Week 15: Review

Final exam: comprehensive.

Attendance Policy, Class Expectations, and Make-Up Policy

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:

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73% - 76%	C	2.00
70% - 72%	C-	1.67
67% - 69%	D+	1.33
63% - 66%	D	1.00
60% - 62%	D-	0.67
0% - 59%	E	0.00

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- 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

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- 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. 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.

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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.

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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>.

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