Quantitative Physiology

BME 4409

Class Periods: MWF, period 3, 9:35am – 10:25am

Location: HPNP G-103

Academic Term: Spring 2023

Instructor: Daniel Ferris, Ph.D. (he/him)
Email: dferris@bme.ufl.edu
Office Phone Number: (352) 294-1281
Office Hours: Wednesdays 10:45am-11:45am; Thursdays 9:30am-10:30am

Learning Assistant: Tran Pham
Email: tpham1@ufl.edu

Course Description

Quantitative modeling of organ system physiology of the nervous system, the cardiovascular system, the renal system, and others will be discussed, and students will work on quantitative problems.

Course Pre-Requisites / Co-Requisites

Pre-requisites with minimum grades of C:

- PCB 3713C - Cell and system physiology or similar course (with instructor approval)
- BME 3053C – Computer Applications for BME
- BME 3060 – Biomedical Engineering Fundamentals
- BME 3508 – Biosignals and Systems

Course Objectives

- to be able to describe a physiologic system in a quantitative way
- to be able to analyze physiologic measurements and use them for parameter estimation

Course Communication

Communication with the instructor is welcome via email or through Canvas. We will also use a course Slack portal that will enable instructor, direct-student, and intra-group communication. Finally, Discussion boards will be available throughout the course for posting thoughts related to course content.

Materials and Supply Fees

None

Professional Component (ABET):

This course incorporates mathematics and basic sciences appropriate to Biomedical Engineering. Basic sciences are defined as biological, chemical, and physical sciences. It also incorporates engineering topics, consisting of engineering sciences and engineering design appropriate to Biomedical Engineering.

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**	Emphasized
2. An ability to 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	Medium	Reinforced

Outcome	Coverage*	
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	Medium	Reinforced
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	Medium	Reinforced

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

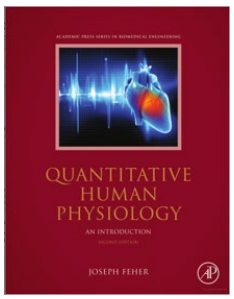
Required Textbooks and Software

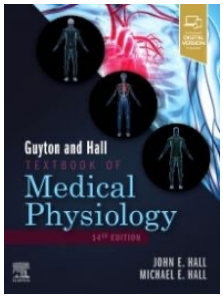
Students will use MATLAB or other software (e.g. Python, Berkeley Madonna) to obtain experience modeling physiological systems.

- MATLAB can be accessed online at http://info.apps.ufl.edu. Full help including FAQ and a Help Request can be found here: https://info.apps.ufl.edu/.
- Alternatively, MATLAB can be accessed by purchasing MATLAB student edition (e.g. from the bookstore).
- Berkeley Madonna can be downloaded at https://berkeley-madonna.myshopify.com/. Students can pay $99 for the educational license, or download the free version. With the free version, you have to save your code as a .txt (or some other type of file) and paste the code into the software each time you use it. The free version does not allow you to save as a Berkeley Madonna model.

Recommended Materials

This course pulls material from a variety of different areas and these three texts cover material that the course will draw on.

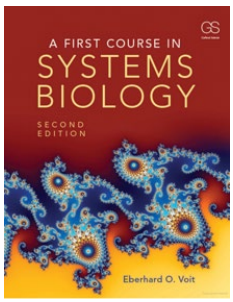




Main Book:

- *Title*: Quantitative Human Physiology
  Author: Joseph Feher
  Publication date and edition: Second Edition (2012)
  Publisher: Academic Press/Elsevier
  ISBN number: 978-0-12-800883-6

Supporting Books:



- *Title*: A First Course in Systems Biology
  Author: Eberhard O. Voit
  Publication date and edition: Second Edition (2017)
  Publisher: Garland Science, Taylor & Francis Group
  ISBN number: 978-0815345688

- *Title*: Guyton & Hall Textbook of Medical Physiology
  Author: John E. Hall & Michael E. Hall
  Publication date and edition: 14th Edition (2020)
  Publisher: Elsevier

ISBN number: 978-0-323-59712-8

Course Structure and Schedule

Format: Face to face, students are expected to attend and participate in the lectures in person. Students will not be able to attend the lectures synchronously via Zoom. Lectures will be recorded and accessible via Canvas for one week. Students can request additional viewing time based on extenuating circumstances. Individual extensions will be up to the discretion of the instructor.

- **Before Class**:
  - Reading: Reading is an opportunity for students to learn and review course material. Reading also provides a perspective on the course material that is different than that provided by the instructor. Most readings are real-world applications of Quantitative Physiology concepts and show how researchers and scientists apply fundamental concepts in BME to a variety of biomedical problems.
    - *Textbook Sections*: The corresponding textbook section/chapters across all three recommended texts is listed on the Canvas webstie. This reading is optional and wherever possible links to digital version of the material are made available through the UF Library.
    - *Journal Articles*: There are a few primary research articles that are required reading for the course, these are found on the Canvas page with links to the article and denoted as Required Reading.
    - *Resources*: The *Resources* section on each Module's Canvas page has real-world application of the concepts we will discuss in class to biomedical problems. Reading of these scholarly works is encouraged to further cement understanding of the material, but it optional.
- **During Class**:
  - Participation: Students are expected to attend scheduled class sessions. Attending class is critical for understanding the course material. The highest total grades are regularly earned by students who come to class having reviewed all assigned materials and are prepared to actively participate in activities and discussions.
  - Class Format: Classes will be a mixture of lecture and interactive activities such as small group problem-solving or stepping through coded models and examples. All code and solutions to any problem-solving activities will be posted on Canvas.
- **After Class**:
  - Assignments: Homework assignments provide students with an opportunity to apply concepts and affirm their understanding of the course material. All assignments should be turned in electronically via the course website. They will be graded as completed (100%) or not completed (0%). Assignments turned in late will be graded at the discretion of the instructor. Students are encouraged to work cooperatively on assignments. However, each student must individually submit assignments consisting of his or her own work. This means that students are encouraged to discuss the solution process for problems. However, copying another student's work (or allowing a student to copy your work) will be considered a violation of the University honor code.
  - Quizzes: Quizzes allow the students and the instructor to assess understanding of current course material. Quizzes will be released after completion of a module and are due at the start of the next scheduled class time.
- **Projects**: There will be two group projects that will provide opportunities to learn, practice, and apply quantitative modeling techniques to biomedical applications. There will be project milestone assignments for each project, and a 5-page report detailing the results of project. The last project will have a final in-class presentation. Groups of 3-4 students will be randomly assigned by the instructor. All project milestones will involve written deliverables and/or in-class presentations. Further project details will be discussed in class and distributed on the course website.

Schedule

The schedule below is tentative and may change according to needs and circumstances. Any revisions will be announced in class and will be posted on Canvas. Notes detail important deadlines within a given week (holidays, project due dates, midterm, etc.) and the assignments associated with the module. Assignments are typically due 1 week after the conclusion of the module. Module Quizzes are due before the start of the next module.

Week	Module	Topic	Notes
1	M1	Introduction to Quantitative Physiology	M1 Quiz
	M2	How to Work in Groups	M2 Quiz
2	M3	What is Modeling?	M3 Quiz, No Class on MLK Jr. Day (Jan. 16th)
3	M4	Homeostasis and Control Systems	M4 Quiz
4	M5	Transport of Substances through Membranes	M5 Quiz
5	M6	Cell Signaling and Metabolism	M6 Quiz
6	M7	Action Potentials and Excitable Cells	M7 Quiz
7	M8	Skeletal Muscle Physiology Modeling	M8 Quiz
8	M9	Nervous System Physiology Modeling	M9 Quiz
9	M10	Cardiovascular Physiology Modeling	M10 Quiz
10		SPRING BREAK	3/13-3/17 - No Class
11	M11	Respiratory Physiology Modeling	M11 Quiz
12	M12	Renal Physiology Modeling	M12 Quiz
13	M13	Gastrointestinal Physiology Modeling	M13 Quiz
	M14	Data Visualization	M14 Quiz
14		Project Group Work	
15		Project Presentations	
16		Project Presentations	

Class Website

- Canvas (elearning.ufl.edu) will be used extensively, including posting all assignments and grades.
- Each student is fully responsible for ensuring that they have access to Canvas and must check the course website routinely to ensure they are fully aware of all assignments and postings.
- Failure to check the course website will not be a valid excuse for not completing an assignment.

Attendance Policy, Class Expectations, and Make-Up Policy

- **Attendance**
  - Regular attendance is expected.
  - How to send an excuse
    - What constitutes a valid excuse? Excused absences must be consistent with University policies in the undergraduate catalog: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/ and require appropriate documentation. Absences will be excused under the following conditions:
      - 24 hours ahead of time that you have a legitimate, unavoidable absence (such as an exam conflict for a higher-numbered academic course)
      - Verifiable medical or family emergency
      - Travel for a student conference – provided all excuse request prior to travel
      - Need to come to class late or leave early for a legitimate reason
    - Contact the instructor at least 24 hours before missing class due to interview confirmation email; conference email; UF official sporting event
  - Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Accommodations for missing an in-class presentation or other assignments will only be made for students who provide appropriate documentation of an excused absence.
- **Expectations**
  - Basic Responsibilities for Student
    - Attendance is critical! The material you will learn is invaluable. In case of absence, you can ask a classmate for lecture material, review the recommended book sections, and access supporting slides and activities on Canvas.

        - Don't be afraid to ask for help during class or office hours.
        - Be an active learner – ask yourself questions during lectures, as you read, and as you attempt problems.
        - Study in advance and go to office hours. Don't wait until the day before a deadline to get clarification on the material.
        - Check Canvas for class updates, assignments, announcements, lessons, calendar, and resources.
        - If using a laptop or other device in class, you shouldn't be on Facebook, Netflix, Hulu, etc. or do other things that are not class replated. If the instructor asks you to put your device away, please do so.
        - You need to notify your instructor if you need accommodations from the Disability Resource Center. Your instructors want to help you.
    - Professional Conduct:
        - Students are expected to engage with the instructor and fellow students in a courteous and professional manner when participating in the classroom via Canvas.
        - Any student who behaves in a disrespectful or disorderly manner may be asked to leave the classroom.
- **Email, Announcements, Feedback, and Communications**
    - Announcements will be shared periodically during class and on Canvas. It is your responsibility to attend class and read the emails/announcements from Canvas.
    - After each assignment is graded, you are responsible for reviewing your instructor's feedback.
    - Emails, announcements, and feedback may occur outside business hours.

Evaluation of Grades

Student performance will be assessed by:

- *Assignments* will be assigned (approximately 1 per module) that will account for 25% of the final grade.
- *Module Quizzes* will account for 25% of the final grade and are due before the start of the next module.
- There will be two *Group Projects*. They will account for 50% of the final grade. Students will work in small groups to develop simple models of a physiological phenomenon and evaluate the model for a specific system. The projects will be evaluated based on a 5-page report detailing the results. There will also be an in-class presentation for the second project. There will be milestone reports prior to submission of the project report.

Assessment	Percentage of Final Grade
HW Assignments	25%
Quizzes	25%
Group Project 1	25%
Group Project 2	25%
TOTAL	100%

Grading Policy

The following grading standards will be used in this class:

Percent	Grade	Grade Points
100 % to 92.0 %	A	4.00
< 92.0 % to 90.0 %	A-	3.67
< 90.0 % to 87.0 %	B+	3.33
< 87.0 % to 83.0 %	B	3.00
< 83.0 % to 77.0 %	B-	2.67
< 77.0 % to 76.0 %	C+	2.33
< 76.0 % to 74.0 %	C	2.00
< 74.0 % to 70.0%	C-	1.67
< 70.0 % to 67.0 %	D+	1.33
< 67.0 % to 64.0 %	D	1.00
< 64.0 % to 61.0 %	D-	0.67
< 61.0 % to 0.0 %	F	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

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/.

Course Recording
Our class sessions may be audio visually recorded for students in the class to refer to and for enrolled students who are unable to attend live. Likewise, students who participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, abstain from verbalizing your contributions. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

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 Honor 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. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. 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:
• Kelly Stalter, BME Undergraduate Academic Advisor, 352-273-8096, undergrad@bme.ufl.edu
• 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 suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Connections 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*: https://distance.ufl.edu/state-authorization-status/#student-complaint*.