

**Quantitative Physiology**  
BME 4409 Section 24902  
**Class Periods:** MWF, period 3, 9:35am – 10:25am  
**Location:** MSB N2-00  
**Academic Term:** Fall 2022

**Instructor:**

Meghan Ferrall-Fairbanks, Ph.D. (she/her)  
Email: [mferrall.fairbanks@bme.ufl.edu](mailto:mferrall.fairbanks@bme.ufl.edu)  
Office Phone Number: (352) 846-2762  
Office Hours: see Canvas for scheduled times

**Teaching Assistant/Peer Mentor/Supervised Teaching Student:** N/A

**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 used 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

This course will use MATLAB as well as open-source languages to give students real-world experience for developing collaborative computing environments.

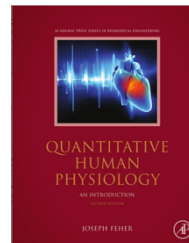
- MATLAB can be accessed online at <http://info.apps.ufl.edu>. Full help including FAQ and a Help Request can be found here: <https://info.apps.ufl.edu/>.
- Alternatively, MATLAB can be accessed by purchasing MATLAB student edition (from the bookstore) OR other access to a computer with MATLAB.

### Recommended Materials

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

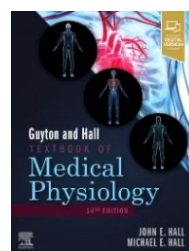
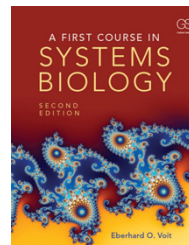
#### Main Book:

- *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
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- *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 Dr. Ferrall-Fairbanks.

### Instructional Delivery Model: Problem-based learning

- **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 in the *To Do List* section of each Module's Canvas page. 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 in the *To Do List* section of each Module's Canvas page with links to the article and denoted as Required Reading. Reading of these articles will be assessed throughout the semester in various Assignments.
    - **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:** Most lectures are structured such that the instructor will introduce concepts during the beginning of class (in the first 35-40 minutes of the class period) and the remainder of the class (the last 10-15 minutes) will be dedicated to applications of the material through 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.
  - **Problem-Based Learning:** In-class, small group problem-solving opportunities provide students with an opportunity to immediately apply concepts from the lecture and firm their understanding of course materials. Periodically throughout the semester, work from these problem-solving opportunities will be submitted on Canvas and count towards a student's participation grade.
- **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. Assignments turned in late will be graded at the discretion of the instructor and with a 5% penalty per day submitted late. 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. They also act as a mechanism to widen the course's grading scheme (i.e., lower the stakes of the midterm exam, assignments, and the project). Quizzes will be released after completion of a module and are due at the start of the next scheduled class time.
- **Course Project:** The design project is an opportunity to learn, practice, and apply quantitative modeling techniques to biomedical applications. There will be three project milestone assignments and a final in-class presentation and 5-page report detailing the results of model. 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
<b>Part 1. Fundamentals</b>			
1	M1	Introduction to Quantitative Physiology	M1 Quiz, Introduction Discussion Board
	M2	How to Work in Groups	M2 Quiz, Group Collaboration Portal Assignment, Collaborative Coding Assignment
2	M3	What is Modeling?	M3 Quiz, Mechanistic Modeling Discussion Board, Modeling Basics Assignment
3			<i>Labor Day – 9/5 – No Class</i> Introduce Semester Project
4	M4	Homeostasis and Control Systems	M4 Quiz, Control Loop Group Presentations
5	M5	Transport of Substances through Membranes	M5 Quiz, Project Milestone 1 Due 9/21
6	M6	Cell Signaling and Metabolism	M6 Quiz, Molecular-Scale Modeling Assignment
7	M7	Action Potentials and Excitable Cells	<i>Homecoming – 10/7 – No Class</i> M7 Quiz, Potentials Assignment
<b>Part 2. Applications to Physiologic Systems</b>			
8	M8	Skeletal Muscle Physiology Modeling	M8 Quiz, Muscle Modeling Assignment
9	M9	Nervous System Physiology Modeling	M9 Quiz, Neuron Assignment, Georgopoulos Discussion Board Project Milestone 2 Due 10/17
10	M10	Cardiovascular Physiology Modeling	Midterm Exam – 10/27 – During Class M10 Quiz, Cardiovascular Assignment
11	M11	Respiratory Physiology Modeling	M11 Quiz Project Milestone 3 Due 11/4
12	M12	Renal Physiology Modeling	<i>Veterans Day – 11/11 – No Class</i> M12 Quiz, Renal Assignment, Integrative Control Discussion Board
13	M13	Gastrointestinal Physiology Modeling	
	M14	Data Visualization	
14		Semester Project Group Work	<i>Thanksgiving Break – 11/23, 11/25 – No Class</i>
15		Semester Project Presentations	All presentations must be uploaded on Canvas by the start of class on 11/28
16		Semester 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 expected in addition to class discussions and satisfactory performance on activities.
- Attendance will be taken in class periodically. Make sure to be in class or send an excuse to your instructor by email or Canvas message.
- 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 student 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 the exam, homework, or project 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 related. 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.
- BME Course Instruction Expectations
  - The purpose of this statement is to share the general UF BME faculty consensus for Fall 2022 course instruction. All BME courses listed in the UF Schedule of Courses are categorized as



in-person; this categorization was present when student signed up to enroll in their courses. The decisions of course format (i.e., whether to offer synchronous zoom participation or recorded Zoom lectures and the extent that an instructor accommodates students) should be made by the instructor. Instructors are not expected to offer "hybrid" format to accommodate a student's internship schedule, desire not to attend class, or preference. Students should notify an instructor of an upcoming absence, and the instructor is required to make accommodations only in the case of university-recognized reasons. Outside of university-recognized reasons, it is at the instructor's discretion whether to accommodate an absence. Course format and accommodations should be selected based on the instructor's aim to enhance individual student and class learning. Note that the college requests for faculty (not required) to post course materials on Canvas with the expectation that students will be getting ill and having to quarantine. Making course materials readily available on Canvas as much as possible will make it easier for students to stay informed and help prevent them from falling behind. The college request does NOT mean offering classes via Zoom.

- **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.
- Please allow up to 48 hours for Dr. Ferrall-Fairbanks to respond or longer if the email is sent at night or during the weekend, holidays, or breaks.

### Evaluation of Grades

Student performance will be assessed by:

- Assignments that will be assigned approximately 1 per module and will account for 25% of the final grade.
- The Semester Project and its accompanying reports and presentations will account for 30% of the final grade. The end goal of the project is to work in small groups to develop a simple model of a physiological phenomenon and evaluate the model for a specific system. The projects will be evaluated based on an in-class presentation and a 5-page report detailing the results and there are 3 milestone reports throughout the semester prior to the final presentation and report.
- Module Quizzes will account for 15% of the final grade and are due before the start of the next module.
- One midterm exam will be administered around Week 10 of and will each account for 20% of the final grade. This midterm exam will assess fundamental concepts in modeling that can be applied to a variety of different physiologic systems.
- Participation will account for 10% of the final grade.

Assessment	Percentage of Final Grade
Assignments	25%
Module Quizzes	15%
Midterm Exam	20%
Semester Project	30%
Participation	10%
	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](mailto:undergrad@bme.ufl.edu)
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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](mailto: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](mailto: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 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>.