BIOE 300B
Quantitative Physiology

Fall 2023 (3 units)
Time: MWF 3:00 - 4:30
Location: 380-380C

Instructor
Paul Nuyujukian
Phone: (650)-724-2685   Email: 23f.300b.bioe@pn.stanford.edu
Student hours: During class work time or by appointment.

TAs
Cyrus Knudsen (head), Kaitlin Harold, & Kenji Marshall
Contact: Compose Canvas Discussion topic or message to teachers on Canvas

Overview
This lecture-based course covers weekly topics in physiology and mathematics for those interested in building intuition surrounding quantifying biological phenomena. While each week’s physiological topic will be different, the mathematical topics will build across weeks, culminating in a final problem set which will bring together the quarter’s scope of math into a single application in neuroengineering (requiring frequency analysis and digital filtering, fitting covariance, eigendecomposition for PCA, and linear classification). Weekly problem sets aim to cover physiological concepts from both an analytical approach and numerical simulation in Python.

Teaching philosophy
I firmly believe that anyone can learn anything they put sincere effort towards. The key to successful learning is the courage to keep trying. I also believe that the answer to a problem is irrelevant. What matters is the sound approach towards, and reasonable justification of, an answer. Further, intricate details of mathematics or physiology are unretainable without developing a guiding intuition. Above all else, the intuition built is what will stay with you in years to come, and I will do my best to impart that to you at every step.

Learning objectives
My goals are that by the end of the quarter you will:

● Explain how different physiological systems function
● Develop intuition behind key mathematical techniques used in engineering
  ○ Recognize situations where each may be useful
  ○ Justify the reasonableness of results
● Model physiological systems using these mathematical techniques
  ○ via numerical simulation in Python
  ○ via analytical equations
Expectations

**Expectations of Instructor**

- Be active and enthusiastic about student learning; convey passion for the material
- Be mindful of each student’s unique experiences, background, and training
- Listen and respect students’ perspectives; understand that students are actively learning
- Explain concepts carefully and clearly; answer student questions in understandable terms
- Create a welcoming and equitable environment with ample opportunity for questions from all
- Be prepared for each class; have videos and readings posted well before class
- Arrive in classroom at least five minutes before start of each class and end lecture promptly
- Grade objectively, fairly, transparently, and promptly
- Adhere to Stanford’s [Honor Code](#)

**Expectations of TAs**

- Be active and enthusiastic about student learning; convey passion for the material
- Be mindful of each student’s unique experiences, background, and training
- Listen and respect students’ perspectives; understand that students are actively learning
- Explain concepts carefully and clearly; answer student questions in understandable terms
- Create a welcoming and equitable environment with ample opportunity for questions from all
- Guide students’ learning and encourage them to think critically about the assignments
- Strike a careful balance with assistance; do not divulge answers to assignments
- Adhere to Stanford’s [Honor Code](#)

**Expectations of Student**

- Be punctual to class
- Listen and respect others
- Complete assignments on time
- Complete readings and videos before each class
- Be active and enthusiastic about learning; student passion fuels learning
- Build and have confidence in yourself and your ability to grasp the material
- Be comfortable taking risks: do not be afraid to make mistakes; mistakes are how you learn
- Put significant, independent effort into the assignments before asking for help
- Ask detailed, thoughtful questions that reflect your understanding of the material
- Discuss any course concerns early with Instructor or TAs after class, during student hours, or privately
- Adhere to Stanford’s [Honor Code](#) and uphold the [Fundamental Standard](#)

**Course websites**

- We will be using Canvas ([http://canvas.stanford.edu](http://canvas.stanford.edu)) for announcements and grades.
Grading
The class grades will be determined by performance in the following areas:

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<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Value each (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework Questions</td>
<td>many</td>
<td>varies</td>
<td>20</td>
</tr>
<tr>
<td>Quizzes</td>
<td>3</td>
<td>15</td>
<td>45</td>
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<tr>
<td>Final exam (comprehensive)</td>
<td>1</td>
<td>30</td>
<td>30</td>
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<tr>
<td>Participation, effort, and contribution to</td>
<td>1</td>
<td>5</td>
<td>5</td>
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<tr>
<td>learning environment</td>
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Final grades are assigned on a sliding scale.

Homework questions
Homework assignments will involve both conceptual questions, analytical questions, and programming in Python. Coding will be conducted in Jupyter notebooks on the Stanford instance of Google Workspace for Education Enterprise platform via Colaboratory: https://colab.research.google.com

All non-coding components of questions will be multiple choice. Some questions have written components, involving explaining the approach and/or justification of an answer. For coding-based questions, code will be submitted electronically and graded on the fly. Grading for coded portions is ramped: the first three submissions are full credit, the next three submissions are 75% credit, the following three submissions are 50% credit, etc.

All questions will be submitted electronically, and feedback on multiple choice selections will be delivered immediately. Multiple choice answers are resubmitted until correct, and credit is awarded based on a linear scale. If a multiple choice question has N choices and required S submissions to arrive at the correct answer, credit for the multiple choice portion of the question is calculated by \( \frac{N-S+1}{N} \).

Students are encouraged to work together on questions, but all students must do their own work and write their own code. Copying of code is not permitted and is a violation of the Honor Code. Homework for a given module is due around the time of each quiz. Each question, or component of a question, submitted before the due date receives full credit. Questions, or components of questions, submitted after the due date are subject to a 15% late penalty for each due date missed.

Quizzes
There will be three quizzes in the course. Quizzes will be two stage exams, a solo portion and a group portion. For the solo portion, quiz questions will be multiple choice, with the option to rank the top 3 choices. The solo portion will be around ½ of the class period. At the end of the solo portion, the quizzes will be collected, and students will be placed into assigned groups for the group portion. Students will answer a single copy of the same quiz, but now as a group using a scratcher. No writing of code will be assessed in the quizzes and no questions will have free response components. The quizzes will be founded on the homework material and reading. They will resemble shorter and/or more conceptual versions of the homework questions. Students should expect quizzes to be novel applications and extensions of the material covered in class. Quiz questions will be graded based on the same formula as homework questions. The breakdown of the final quiz score will be 75% solo portion and 25% group portion (where the group portion cannot lower the grade).
Missing quizzes
Students are expected to be present for each assessment. Consult with the instructor if there are conflicts with a quiz. There is no guarantee of a make-up exam and group portions are not repeatable.

Final Exam
A final exam is administered during finals week. It will be in the same format and nature of questions as the quizzes. It will be comprehensive, with slightly higher emphasis for post Quiz3 content.

Participation, effort, and contribution to learning environment
This category comprises a small, but important aspect of the final grade. Each student starts with half credit in this category. Active participation, effort, and contributions to a positive learning environment will increase this score. Lack of effort and detracting from the learning environment will decrease this score. Examples of contributing to a positive learning environment include being respectful of class time, demonstrating genuine curiosity and engagement in the material, helping others students when opportunity arises, and being supportive of your peers’ learning. Examples of negative contributions to the learning environment may include talking out of turn or otherwise disrupting the class; subverting the spirit of class exercises, homework assignments, or assessments; or intentionally misleading or misinforming students. Violations of the Honor Code will be referred to the Office of Community Standards.

COVID-19 Policies
The University sets the COVID-19 policies and makes them available online. Masks are required in class. Students are required to be vaccinated if present on campus.

Textbooks & external resources
No textbooks are required for this class. All readings will be made available in PDF format. A list of videos for the course content are generally provided three nights before the lecture. One of the key textbooks that will be referred to is Guyton Physiology. The full text is available electronically here via the Stanford Library.

Generative AI Policy
In pursuit of this course’s learning goals, when completing assignments, students may use any/all available resources, including internet resources, generative AI tools, etc. The work that students submit for credit may be derived from such resources, but cannot be copied verbatim. To promote equity, all students are permitted to use free generative AI resources available at http://llm.stanford.edu. This is a course-specific policy that permits usage of resources beyond the more restrictive University-wide generative AI policy guidance: https://communitystandards.stanford.edu/generative-ai-policy-guidance.

Academic accommodations for different needs
Students who may need academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: http://oae.stanford.edu).
Stanford University and its faculty are committed to ensuring that all courses are financially accessible to all students. If you are an undergraduate who needs assistance with the cost of course textbooks, supplies, materials and/or fees, you are welcome to approach the instructor directly. If you would prefer not to approach the instructor directly, please note that you can ask the Diversity & First-Gen Office for assistance by completing their questionnaire on course textbooks & supplies: [http://tinyurl.com/jpqbarn](http://tinyurl.com/jpqbarn) or by contacting Joseph Brown, the Associate Director of the Diversity and First-Gen Office (jlbrown@stanford.edu; Old Union Room 207). Dr. Brown is available to connect you with resources and support while ensuring your privacy.

Changes
The syllabus is subject to change as needed. The last update to this syllabus was 2023/09/26.