

MCEN 4117/5117: Quantitative Physiology for Engineers

A. COURSE OBJECTIVES:

The main objective of this multidisciplinary course is to explore human physiological function from an engineering, specifically mechanical engineering, viewpoint. It provides an introduction to human anatomy and physiology with a focus on learning fundamental concepts and applying quantitative and engineering (mass transfer, fluid dynamics, mechanics, modeling) analysis. Students will also learn to perform literature reviews and read scientific literature, in particular, graduate students are required to perform critical evaluations of the literatures related to physiology, pathology or in-silico modeling of physiological processes. For PhD students, the course also helps them to prepare for the preliminary exam in the bioengineering track, which requires that “Every student is responsible for Units 1-3, and then each student must choose 2 ‘systems’ from Units 4-9 (nervous, cardiovascular, respiratory, renal, GI, endocrine)”.

B. BASIC INFORMATION

Course instructor: Prof. Wei Tan

Contact information: ECOT 516, Phone: (303)492-0239, Email: wtan@colorado.edu

Class hours & locations: 5 to 6:15pm, Tues & Thurs

Office hours: By appointment ONLY on Tuesdays, 11am-4pm

TA/Grader: Winston Elliott. Email: welliott@baiwe.net, by appointments.

Prerequisite courses: Undergraduate-level mathematics, fluid mechanics, mechanics, thermodynamics, college chemistry and biology

Web Page: D2L site: learn.colorado.edu

C. GRADING:

Team-based Projects [†] :	40%
Lab reports:	5%
In-class Presentations:	5%
Homework:	10%
Quizzes (Reading quizzes + in-class quizzes) [%] :	15%
Final exam or paper (to be announced in the middle of the semester):	20%
Workshop/discussion, class participation*, and on-time peer review:	5%

[†] Graduate students: 4 students per team; Undergraduate students: 5-6 students per team.

[%] Reading quizzes: Questions related to learning goals of each chapter subunit. Open-book; work on-line and graded online. Allow two attempts. Passing the quiz needs 80% or above accuracy, which will result in full score or 100 on the quiz. If not passing the quiz (below 80%), your score will be the percentage of correct answers (e.g. 70). *Two lowest reading quiz scores won't count towards the final grade. One lowest in-class quiz score also won't count towards the final grade.*

* Extra credit opportunity. *Class Participation:* There will always be opportunities for you to participate during class time. Be sure to complete the in-class assignments. Being an active and proactive student is crucial. Continuously showing leadership and critical thinking in these assignments will be rewarded with extra credits.

** For reading quizzes and homework assignments, students are required to work individually on all assignments. No late turn-in except rare cases with convincing evidence present.

** Presentations: Two presentations for each group – one on team-based projects (15 minutes) and the other on lab reports (10 minutes).

D. TEXTBOOK:

- (Required) ***Quantitative Human Physiology: An Introduction***, by Joseph Feher
- Unit 1 Physical and Chemical Foundations of Physiology
 - Unit 2 Membranes, Transport, and Metabolism (Partial, 2.1-2.7)
 - Unit 3 Physiology of Excitable Cells
 - Unit 5 Cardiovascular System (only first section of 5.11, excluding 5.12 or 5.13)
 - Unit 6 Lung / Respiratory System (excluding 6.6)
 - Unit 7 Renal System

E. COURSE SYLLABUS:

- 1. Introduction & Unit 1a** (Core Principles and Physical Foundations of Physiology)
Week 1 (1/17, 1/19)
Reading assignment: Chapter 1.1-1.3
- 2. Unit 1b** (Chemical Foundations of Physiology & Diffusion)
Week 2 (1/24, 1/26)
Reading assignment: Chapter 1.4-1.6
Reading quiz – 1, online, completed by 11:59pm, Monday, **1/23**
HW1: due on **1/31**
- 3. Unit 1c** (Electrochemical Potential) **& Unit 2a** (Cell & DNA)
Week 3 (1/31, 2/2)
Reading assignment: Chapter 1.7 & 2.1-2.2
In-class quiz on Unit 1.
- 4. Unit 2b** (Protein, Biological Membrane, Passive Transport)
Week 4 (2/7, 2/9)
Reading assignment: Chapter 2.3-2.5
Reading quiz – 2, online, completed by 11:59pm, Monday, **2/6**
- 5. Unit 2c** (Active Transport, Osmosis) **& Unit 3a** (Resting potential)
Week 5 (2/14, 2/16)
Reading assignment: Chapter 2.6-2.7, 3.1
Reading quiz – 3, online, completed by 11:59pm, Monday, **2/13**
In-class quiz on Unit 2.
HW2: due on **2/14**
- 6. Unit 3b** (Action potential & Skeletal Muscle)
Week 6 (2/21, 2/23)
Reading assignment: Chapter 3.2-3.4
Reading quiz – 4, online, completed by 11:59pm, Monday, **2/20**
- 7. Unit 3c** (Neuromuscular Junction & Muscle Energetics & Smooth muscle)
Week 7 (2/28, 3/2)
Reading assignment: Chapter 3.5-3.8
Reading quiz – 5, online, completed by 11:59pm, Monday, **2/27**
- 8. Unit 5a** (Cardiovascular system overview & Blood cells & Heart as pump)
Week 8 (3/7, 3/9)

Reading assignment: Chapter 5.1-5.4

Reading quiz – 6, online, completed by 11:59pm, Monday, **3/6**

HW3: due on **3/14**

9. Unit 5b (Cardiac AP, ECG, contractility & function)

Week 9 (3/14, 3/16)

Reading assignment: Chapter 5.5-5.8

Reading quiz – 7, online, completed by 11:59pm, Monday, **3/13**

10. Unit 5c (Vascular function, Microcirculation & Perfusion)

Week 10 (3/21, 3/23)

Reading assignment: Chapter 5.9-5.11

Reading quiz – 8, online, completed by 11:59pm, Monday, **3/20**

HW4: due on **4/4**

SPRING BREAK

11. Catch up the progress in case of delays due to in-class presentations and quizzes

Week 11 (4/4, 4/6)

In-class quiz on Unit 5.

12. Unit 6a (Breathing mechanics & resistance + Gas exchange & transport in the lung)

Week 12 (4/11, 4/13)

Reading assignment: Chapter 6.1 - 6.3

Reading quiz – 9, online, completed by 11:59pm, Monday, **4/10**

13. Unit 6b / Unit 7a (Acid-base physiology and body fluids)

Week 13 (4/18, 4/20)

Reading assignment: Chapter 6.4-6.5, 7.1-7.2

Reading quiz – 10, online, completed by 11:59pm, Monday, **4/17**

In-class quiz on Unit 6.

HW5: due on **4/27**

14. Unit 7b (Renal functions, glomerular filtration, and fluid/electrolyte balance)

Week 14 (4/25, 4/27)

Reading assignment: Chapter 7.3 - 7.7

Reading quiz – 11, online, completed by 11:59pm, Monday, **4/24**

15. Finish lectures & Review & Presentations

Week 15 (5/2, 5/4)

In-class presentations and quiz

F. COURSE POLICY

Any incident of academic dishonesty will lead to an automatic F grade for the course. Exchange of helpful suggestions is ok, but using another student's work (or allowing another student to use your work) is not ok. Description of academic integrity and climate is attached. Special issues: if you qualify for accommodations because of a disability, please submit to the instructors a letter from Disability Services in a timely manner so that your needs may be

addressed. For details, visit this Web site:www.Colorado.EDU/disabilityservices. Some students may have serious religious obligations which may conflict with academic requirements such as scheduled exams. The full text of the policy regarding this conflict can be read on the web at http://www.colorado.edu/policies/fac_relig.html. In addition, the University has recently adopted a student Honor Code, which is described at <http://www.colorado.edu/policies/honor.html>

Academic Integrity

You will be asked to complete individual homework assignments in this course. Though you may work in groups to discuss and solve problems, it is expected that you will abide by the University of Colorado at Boulder honor code at all times. Therefore, you may not plagiarize a problem set or allow another student to plagiarize your answers to a problem set. Examples of plagiarism include: copying from a solution manual, copying from Internet sites, copying from previous academic year homework sets, and copying directly from classmates. If you have any doubt that you are using sanctioned materials to assist with your homework solution, please ask your current instructor/professor. On assignments that require you to use supplemental materials, it is also essential that you properly document the sources of information you use.

Any instances of dishonesty on homework or tests will result in a minimum sanction for your first violation of the honor code of a zero score and an entry in your department file. Additional sanctions will be imposed by the ME Department for subsequent violations, possibly including expulsion from the ME program. You may contest any accusation according the campus honor code system.

University of Colorado at Boulder Honor Code Policy:

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at <http://www.colorado.edu/policies/honor.html> and at <http://www.colorado.edu/academics/honorcode/>

Academic Climate

In Class Expectations:

It is our expectation that each of you will be respectful to your fellow classmates and instructors at all times. In an effort to create a professional atmosphere within the classroom, it is requested that you:

- Arrive to class on time
- Turn off your cell phone
- Limit use of your laptop computer to class purposes
- Put away newspapers and magazines
- Refrain from having disruptive conversations during class
- Remain for the whole class, or if you must leave early do so without disrupting others
- Display professional courtesy and respect in all interactions related to this class

Compliance with these expectations will assist us with the creation of a learning community and a high quality educational experience. The University of Colorado Classroom behavior policy will compliment the outlined classroom expectations.

University of Colorado Classroom Behavior Policy:

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at

<http://www.colorado.edu/policies/classbehavior.html> and at

http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

Out of Class Expectations:

Though many of the above stated policies address academic climate within the classroom, these policies should also be upheld outside of the classroom. As a member of the ME community you are expected to consistently demonstrate integrity and honor through your everyday actions. Furthermore, faculty and staff members are very willing to assist with your academic and personal needs. However, multiple professional obligations make it necessary for us to schedule our availability. Suggestions specific to interactions with faculty and staff include:

- Respect posted office hours. Plan your weekly schedule to align with scheduled office hours
- Avoid disrupting ongoing meetings within faculty and staff offices. Please wait until the meeting concludes before seeking assistance. Respect faculty and staff policies regarding use of email and note that staff and faculty are not expected to respond to email outside of business hours. Send emails to faculty and staff using a professional format. Tips for a professional email include:
 - Always fill in the subject line with a topic that indicates the reason for your email to your reader.
 - Respectfully address the individual to whom you are sending the email (e.g., Dear Professor Smith).
 - Avoid email, chat room or text message abbreviations.
 - Be brief and polite.
 - Add a signature block with appropriate contact information.
 - Reply to emails with the previously sent message. This will allow your reader to quickly recall the questions and previous conversation.