

## 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 ~~and~~ 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)

addressed. For details, visit this Web site:[www.Colorado.EDU/disabilityservices](http://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](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, please refer to the following policies: 2.6(r), 2.6(e), 4.4(qui), 2.3(r), 2.7(e), 4.7(uc), 4.4(nt), 2.6(4), 4.3(Y), 4.4(nt), 2.3C

