BE 508: Quantitative Studies of Respiratory and Cardiovascular Systems

Spring Semester, 2015

Classes: Monday & Wednesday 4-6:PM, PHO 202
Laboratory: Thursday 7-10:PM, BME Teaching Lab in Room 209

Instructors:

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Textbooks:

J. B West, “Respiratory physiology—the essentials”. Lippincott Williams & Wilkins, 2011

Additional Material:
Handouts of lectures and research papers from various journals will be distributed.

Goals:
The course provides an introduction to:
1. quantitative modeling in respiratory and cardiovascular physiology
2. structure-function relationships of the respiratory system
3. the structure-function relationships of the cardiovascular system
4. instrumentation and measurement techniques for assessing respiratory and cardiovascular function

Main Topics:
1. Introduction: anatomy, physiology and models of the respiratory system (1 lecture) (Handout)
2. Measurements and basic modeling of respiratory function (2 lectures) (Bates, Ch 1&2)
   a. Ventilation, perfusion, and gas exchange
   b. Instrumentation and theory of measurement
3. Lung Imaging (1 lecture)
4. Scaling concepts in physiology (1 lecture) (Handout)
5. Models of the human airway tree (1 lecture) (Handout)
6. Respiratory mechanics (1 lecture) (Bates, Ch 5)
7. Forward modeling of respiratory mechanics (1 lecture) (Handout)
8. Inverse modeling of respiratory mechanics, part 1 (2 lectures) (Bates, Ch 3)
   a. Time-domain approaches
9. Basic fluid mechanics for physiology (1-2 lectures) (Handout)
   a. Poiseuille flow
b. Womersley flow
10. Forced oscillations (1 lecture)  
11. Inverse modeling of respiratory mechanics, part 2 (1 lecture)  
   a. Frequency-domain approaches
12. Respiratory pathophysiology (2-3 lectures)  
   a. Asthma  
   b. COPD  
   c. Acute lung injury / ARDS  
   d. Mechanical ventilation
13. Cardiac physiology (2 lectures)  
14. Hemodynamics and cardiovascular modeling (2 lectures)  
15. Graduate student presentations  
   a. Grad student to present one research paper  
   b. 15-20 minutes

Laboratory:
A comprehensive set of laboratory exercises will be given including the following topics:
   • image analysis to estimate physiological parameters
   • Inverse modeling of respiratory mechanics
   • Development of morphometric models of the respiratory system
   • Simulation of lung disease in morphometric models
   • Cardiovascular modeling

Students are encouraged to discuss laboratory assignments with classmates. However, directly copying a classmate’s work or allowing a classmate to knowingly copy your work is not allowed. A good rule to follow is, never share written versions of lab reports or computer code.

Homework:
Homework will be given from several topics.

Grading:
Graduate Students Undergraduate Students
Laboratory 30% Laboratory 35%
Homework 10% Homework 15%
Midterm exam 20% Midterm exam 20%
Presentation 15% Final exam 30%.  
Final exam 25%

Note: Students must earn at least 50% of the grade in order to obtain a passing grade (D).

Copyright and Use of Recording Devices:
Slides will be distributed to the class before or immediately after each lecture. Please note that all course materials (labs, homeworks, handouts, etc) are for students of this course ONLY. Use of recording devices (video or audio) is prohibited by law without prior consent and permission of the instructor. Refer to Mass. Gen. Laws ch. 272, § 99.

Incompletes & Withdrawals:
Incomplete will be given to students demonstrating good progress (C or better) with acceptable reason for being unable to complete the course. Students may withdraw from course prior to the University deadline. Having taken the final exam, students will not be able to receive an incomplete or withdraw.