BE 508: Quantitative Studies of Respiratory and Cardiovascular Systems

Spring Semester, 2013

Classes: Tuesday & Thursday 4-6:PM, PHO 202
Laboratory: Thursday 7-10:PM, ERA 209

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Office hours: Thursday 6-7:PM

Textbooks:

Additional Material:
Research papers from various journals (will be distributed)

Goals:
1. To provide an introduction to structure-function relationships of the respiratory system
2. To provide an introduction to the structure-function relationships of the cardiovascular system
3. To introduce quantitative models of the cardio-pulmonary systems
4. To introduce instrumentation and measurement techniques for assessing cardio-pulmonary function

Main Topics:

1. Basic anatomy and physiology of the respiratory system (1 lecture)  (Bates, Ch 1)
2. Measurement of respiratory function (2 lectures)  (Bates, Ch 2)
   a. Spirometry
   b. Plethysmography
   c. Instrumentation and theory of measurement
3. Respiratory mechanics (1 lecture)  (Bates, Ch 5)
4. Inverse modeling of respiratory mechanics, part 1 (2 lectures)  (Bates, Ch 3)
   a. Time-domain approaches
5. Basic fluid mechanics for physiology (1-2 lectures)  (Handout)
   a. Poiseuille flow
   b. Womersley flow
6. Forced oscillations (2 lectures)  (Bates, Ch 8)
7. Inverse modeling of respiratory mechanics, part 2 (2 lectures) (Bates, Ch 9)
a. Frequency-domain approaches

8. Forward modeling of respiratory mechanics (1 lecture) (Handout)

9. Respiratory pathophysiology (2-3 lectures) (Handout)
a. Asthma
b. COPD
c. Acute lung injury / ARDS
d. Mechanical ventilation

10. Lung Imaging (1 lecture)

11. Cardiac physiology (2 lectures) (Handout)

12. Hemodynamics (2 lectures) (Handout)

13. Cardiovascular modeling (1 lecture) (Handout)

14. Graduate student presentations
   a. Grad student to present one research paper
   b. 15-20 minutes

15. Comparative physiology / special topics (1 lecture, if time allows) (Handout)

Laboratory:
A comprehensive set of laboratory exercises will be given including the following topics:
- Inverse modeling of respiratory mechanics during ventilation
- Inverse modeling of respiratory mechanics in disease
- 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:

<table>
<thead>
<tr>
<th>Graduate Students</th>
<th>Undergraduate Students</th>
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<tbody>
<tr>
<td>Laboratory 30%</td>
<td>Laboratory 35%</td>
</tr>
<tr>
<td>Homework 10%</td>
<td>Homework 15%</td>
</tr>
<tr>
<td>Midterm exam 20%</td>
<td>Midterm exam 20%</td>
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<tr>
<td>Presentation 15%</td>
<td>Final exam 30%</td>
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<tr>
<td>Final exam 25%</td>
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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.