Physiology for Bioengineers  BIM 204

Time: T - Th  8:00 – 9:50 am                    Room: 1007 Giedt Hall
Instructor:  Craig Benham (cjbenham@ucdavis.edu)
Offices: 2144 Math-Statistics Bldg and 4331 GBSF
Office Phone:  754-8159 (Math) or 754-9647  (Genome Center)
Office Hours: Tu 10 - 11 am (catch me right after class), and W 3 - 4 in GBSF 4331. Other
times on request; email for appointment

There is extensive reading available in the text for each physiological system covered. However,
not all topics presented in the course are covered in the book, and many topics that are found in
the book will not be treated in the course at the same depth. The students are expected to
master the material in this course at the level it is presented in the classes.

There is a course SmartSite, on which important course materials will be posted. The instructor
will either email or post on the Resources section of the SmartSite a handout version of the slides
for each lecture. Where possible, this will be done by 11 am each class day for the lecture to be
given that day. Students are strongly encouraged to download these handouts, print them out,
take them to class and take notes on them.

There will be two midterms and a final exam. The first midterm will be a take home exam. It
will be given out on Tuesday, Oct 12, to be returned Tuesday, October 19. The second midterm
will be given during class on November 9. The final exam is 3:30 – 5:30 pm on Tuesday,
December 7. The second midterm and the final exams are both given in the classroom, Giedt
1007.

Grading:  Midterm 1  20%
           Midterm 2  30%
           Final  50%
Course Syllabus
BIM 204 F’08

This course will treat eight physiological systems, with brief introductions to other areas as time permits. Each system will be described, and a selection of topics will be treated at greater depth. Emphasis will be placed on engineering principles in physiology. Possible examples may include control systems, continuum mechanics, electrochemistry, fluid dynamics, transport processes, countercurrent exchange, signal transduction, compartmental models and/or dimensional analysis.

0. Physical chemistry; transport processes
1. Neuronal and Sensory Systems
   - Electrochemical Equilibrium
   - Action potentials and their transmission; Hodgkin-Huxley; excitability
   - Synapses – transmission of action potentials between cells
   - Components of the nervous system
     - Peripheral and central nervous systems
     - The autonomous nervous system and its control
     - Some sensory systems
2. Muscle
   - Contractility and energy use in muscles
   - Muscle structure
   - Skeletal and smooth muscle
3. Cardiovascular System
   - Properties of blood and the structure of the circulatory system
   - Hemodynamics in pipes and in compliant vessels
   - The cardiac pump
   - Electrophysiology of the heart
   - Regulation of the heartbeat: Control of cardiac output
4. Introduction to the Lymphatic System
5. Respiratory System
   - Structure and function of the respiratory system
   - Mechanics of breathing
   - Ventilation, perfusion, transport of O₂ and CO₂
   - Control of breathing
6. Endocrine System
7. Renal System (Kidneys)
   - Countercurrent exchangers and renal function
   - Control of osmolality and volume: electrolyte homeostasis, acid-base balance
8. Gastrointestinal System
Daily Syllabus (approximate) and Chapters Covered

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/23 Th</td>
<td>Orientation; Physical Chemistry, Transport Processes</td>
<td>2, 3, 5</td>
</tr>
<tr>
<td>9/28 Tu</td>
<td>Membrane Equilibria; Electrochemistry and Action Potentials</td>
<td>6, 7</td>
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<tr>
<td>9/30 Th</td>
<td>Synapses, Neurons and the Nervous System</td>
<td>8, 10, 11, 12</td>
</tr>
<tr>
<td>10/5 Tu</td>
<td>The Brain, Peripheral and Sensory Systems</td>
<td>10, 13, 14</td>
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<tr>
<td>10/7 Th</td>
<td>The Senses; The Autonomic Nervous System; Efferents</td>
<td>13, 14, 15</td>
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<tr>
<td>10/12 Tu</td>
<td>Somatic Systems, Skeletal Muscle</td>
<td>16, 9</td>
</tr>
<tr>
<td>10/14 Th</td>
<td>Muscle Mechanics; Smooth Muscle</td>
<td>9</td>
</tr>
<tr>
<td>10/19 Tu</td>
<td>Cardiovascular system overview; The Heart as a Pump</td>
<td>17, 22</td>
</tr>
<tr>
<td>10/21 Th</td>
<td>The Cardiac Cycle; Cardiac Function</td>
<td>22, 23</td>
</tr>
<tr>
<td>10/26 Tu</td>
<td>Hemodynamics</td>
<td>17</td>
</tr>
<tr>
<td>10/28 Th</td>
<td>Circulatory System I</td>
<td>17, 18, 19</td>
</tr>
<tr>
<td>11/2 Tu</td>
<td>Circulatory System; gas transport; control systems</td>
<td>22, 23, 24</td>
</tr>
<tr>
<td>11/4 Th</td>
<td>The Pulmonary System</td>
<td>25, 26</td>
</tr>
<tr>
<td>11/9 Tu</td>
<td>Midterm exam</td>
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</tr>
<tr>
<td>11/11 Th</td>
<td>Veteran’s Day Holiday</td>
<td></td>
</tr>
<tr>
<td>11/16 Tu</td>
<td>Pulmonary functions</td>
<td>27, 31, 32</td>
</tr>
<tr>
<td>11/18 Th</td>
<td>Pulmonary System, Endocrine System, Renal System</td>
<td>29, 30, 47</td>
</tr>
<tr>
<td>11/23 Tu</td>
<td>Renal System</td>
<td>33 – 39</td>
</tr>
<tr>
<td>11/25 Th</td>
<td>Thanksgiving holiday</td>
<td></td>
</tr>
<tr>
<td>11/30 Tu</td>
<td>Renal System; Gastrointestinal System</td>
<td>36, 38, 39, 41</td>
</tr>
<tr>
<td>12/2 Th</td>
<td>Gastrointestinal System</td>
<td>42 - 46</td>
</tr>
</tbody>
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The instructor will email to the students handout version of the slides for each lecture. Whenever possible this will be done by 3 pm for a class the following day. These handouts also will be posted to the Resources section of the course SmartSite. **Students are strongly encouraged to download these handouts and use them to take additional notes on in class.** Students also are strongly encouraged to read ahead of the lectures in the book.