MEDBIO 3501A / BIOPHYS 9501A – Biophysics of Transport Systems

1. Course Information

Course summary
The biophysics and physiology of the cardiovascular and pulmonary systems in health and disease, including cellular biophysics, cardiac function, physics of blood flow, vascular mechanics in the microcirculation and large vessels, surface energy and interactions at biological interfaces such as the lung, diffusive and convective transport and exchange.

Pre or Corequisites
Prerequisite(s): One of Calculus 1000A/B, Calculus 1500A/B, Mathematics 1225A/B, Applied Mathematics 1413; one of Physics 1028A/B, Physics 1301A/B, Physics 1401A/B or Physics 1501A/B, and one of Physics 1029A/B, Physics 1302A/B, Physics 1402A/B or Physics 1502A/B. Typically taken in third year, this course is also open to second-year students with an overall average of at least 70% in first year.

Prerequisite checking – the student’s responsibility
Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Extra Information: 2 lecture hours; 1 tutorial hour.  
Breadth: Category C  
Subject code: MEDBIO

Course Weight: 0.5

Accessibility Statement
Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Student Accessibility Services at 519-661-2147 for any specific question regarding an accommodation.

Fall 2019 Timetable

<table>
<thead>
<tr>
<th>Section</th>
<th>Component</th>
<th>Days</th>
<th>Start Time</th>
<th>End Time</th>
<th>Location</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>LECTURE</td>
<td>Tu, Th</td>
<td>1:30 PM</td>
<td>2:30 PM</td>
<td>WSC-240</td>
<td>McGuire</td>
</tr>
<tr>
<td>002</td>
<td>TUTORIAL</td>
<td>Tu</td>
<td>12:30 PM</td>
<td>1:30 PM</td>
<td>NCB-293</td>
<td>McGuire</td>
</tr>
<tr>
<td>003</td>
<td>TUTORIAL</td>
<td>W</td>
<td>11:30 AM</td>
<td>12:30 PM</td>
<td>PAB-117</td>
<td>McGuire</td>
</tr>
</tbody>
</table>

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2. Instructor Information
Instructor and Course coordinator
John McGuire, PhD, MBA
Associate Professor
Office: MSB-411 D
Department of Medical Biophysics
Telephone (office): 519-661-2111 ext. 86253
Schulich School of Medicine & Dentistry
John.McGuire@schulich.uwo.ca
Western University
London, ON Canada
Offices hours: Please email to arrange an appointment.

Teaching Assistants
Olivia Sehl osehl@uwo.ca
Xi Yue Wang xwan9@uwo.ca
Jaryd Christie jchris63@uwo.ca
Please use the times assigned for Tutorials to seek assistance and ask questions of the Teaching Assistants

Academic Programs Coordinator (Medical Biophysics)
Kathleen Petts
Department of Medical Biophysics
Office: MSB-407
Schulich School of Medicine & Dentistry 519-661-2111 ext. 88030
Western University kathleen.petts@schulich.uwo.ca
London, ON Canada

3. Course Syllabus
Teaching Rationale
Lectures introduce fundamental background for physiology and biophysics concepts. The organization, structure and function of selected components of human cardiovascular and pulmonary systems are considered in the context of their function as biological transport systems. The first half of each lecture series is weighted heavily on introducing foundational concepts, which may be a review for some and new for other students. This is necessary for establishing a common baseline that allows for discussions later in the course. The application of biophysics and quantifying cardiovascular function, structure and behavior is highlighted using examples from medicine.

Tutorials are an opportunity for students to discuss the current assignment with instructors and work on problem solving skills and writing as individuals or in groups. Students are encouraged to ask questions to learn about any course material covered in lectures throughout the term.

Students are expected to become familiar with all required course readings and course materials posted on OWL, attend all lectures and tutorials, complete all assignments, and examinations. Students are encouraged to become familiar with the recommended reading lists.

Course Learning Outcomes
By the end of this course, students should
1. Understand the function and structure of human cardiovascular and pulmonary systems;
2. Be able to identify and calculate physics concepts and formulas, including those related to blood flow, blood pressure, cardiac function, diffusion, gas exchange, partial pressures;
3. Be able to apply this knowledge and critically read literature;
4. Be able to apply physics concepts to solve common problems encountered in cardiovascular and pulmonary disease.

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Lecture Series Outline by Teaching Themes and Learning outcomes

Lecture One: Introduction to the circulatory system: a biological transport system
Students will acquire fundamental knowledge about the organization of the circulatory system.

Lecture Two: Biophysics Principles
Students will acquire fundamental knowledge of the physics principles of blood flow, material transport by blood flow, and the Fick principle.

Lecture Three: The heart, the vasculature, and the blood.
Students will acquire foundational knowledge about the structure and function of the circulatory system.

Lectures Three to Five: Cellular biophysics of cardiac cells
Students will acquire foundational knowledge about cardiac cells and relate biophysics concepts to cell function.

Lectures Six to Nine: The heart as a pump
Students will acquire foundational knowledge of the cardiac cycle, and the electrical and mechanical properties of the heart. Physics concepts and formulas used for calculations of cardiac function will be introduced and applied. Application of diagnostic instrumentation used to measure cardiac function will be introduced.

Lectures 10 to 16: Peripheral vascular system and vascular control; blood and the microcirculation
Students will acquire foundational knowledge about biophysical properties of vascular smooth muscle and endothelial cells; the structure and function of blood vessels; vascular control and distribution of blood flow; transcapillary transport, blood and the behavior of red blood cells in the microcirculation.

Lectures 17 to 19: Pulmonary system and biophysics
Students will acquire foundation knowledge of specific biophysical properties and principles related to the function and structure of the respiratory system including gas exchange in the lungs, alveolar ventilation, and surfactants.

Lecture 20: Oxygen transport and diffusion
Students will acquire foundational knowledge of oxygen transport and diffusion in the context of the microcirculation.

Lecture 21 to 24: Synthesis and application of biophysics to circulatory and respiratory health and disease
Students will apply acquired knowledge and concepts to solve problems associated with common circulatory, and respiratory diseases.

The thematic teaching outline is provided as a guide to the estimated pace of covering the various themes.

The Fall 2019 term schedule below indicates the dates for lectures, tutorials and exams, and the submission due dates for assignments.
### Course Schedule Fall 2019

<table>
<thead>
<tr>
<th>Week number</th>
<th>Monday</th>
<th>Tutorial section</th>
<th>Thursday</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sept 2-6</td>
<td></td>
<td>Sept 5 Lecture 1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sept 9-13</td>
<td>Sept 10 TA teach Lecture 2</td>
<td>Sept 12 Lecture 3</td>
<td>Sept 20 Due by noon Assignment 1 10%</td>
</tr>
<tr>
<td>3</td>
<td>Sept 16-20</td>
<td>Sept 17 Lecture 4</td>
<td>Tutorial 2</td>
<td>Sept 19 Lecture 5</td>
</tr>
<tr>
<td>4</td>
<td>Sept 23-27</td>
<td>Sept 24 Lecture 6</td>
<td>Tutorial 3 Assignment discussion</td>
<td>Sept 26 Lecture 7</td>
</tr>
<tr>
<td>5</td>
<td>Sept 30-Oct 4</td>
<td>Oct 1 Lecture 8</td>
<td>Tutorial 4</td>
<td>Oct 3 Lecture 9</td>
</tr>
<tr>
<td>6</td>
<td>Oct 7-11</td>
<td>Oct 8 Lecture 10</td>
<td>Tutorial 5</td>
<td>Oct 10 Lecture 11</td>
</tr>
<tr>
<td>9</td>
<td>Oct 28-Nov 1</td>
<td>Oct 29 Midterm exam</td>
<td>No tutorials</td>
<td>Oct 31 Lecture 16</td>
</tr>
<tr>
<td>10</td>
<td>Nov 4-10</td>
<td>Fall reading week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Nov 11-15</td>
<td>Nov 12 Lecture 17</td>
<td>Tutorial 8</td>
<td>Nov 14 Lecture 18</td>
</tr>
<tr>
<td>12</td>
<td>Nov 18-22</td>
<td>Nov 19 Lecture 19</td>
<td>Tutorial 9</td>
<td>Nov 21 TA teach Lecture 20</td>
</tr>
<tr>
<td>13</td>
<td>Nov 25-Nov 29</td>
<td>Nov 26 Lecture 21</td>
<td>Tutorial 10 Assignment discussion</td>
<td>Nov 28 Lecture 22</td>
</tr>
<tr>
<td>14</td>
<td>Dec 2-6</td>
<td>Dec 3 Grad student presentation</td>
<td>Tutorial 11 Final exam preparation</td>
<td>Dec 5 Grad student presentation</td>
</tr>
<tr>
<td>15</td>
<td>Set by the Registrar</td>
<td>Final exam</td>
<td></td>
<td>Final Exam 40%</td>
</tr>
</tbody>
</table>
4. Course Materials

Please access the course website through OWL at https://owl.uwo.ca/portal

- Students with OWL issues should contact the Computer Support Centre at 519 661-3800

Instructors will post lecture materials on the course website.

Course Readings will be accessible by logging into OWL, Course Readings or Western Libraries Electronic Reserves using your Western account. A hard copy of each textbook will be available for temporary loan through Library Reserves. Students can purchase their own licenses for the e-textbooks from the publisher or access them through the Course Readings and OWL.

- Due to licensing restraints, there is a limit to the maximum number of users that can access simultaneously the AccessMedicine online textbooks versions of the Cardiovascular Physiology, and Pulmonary Physiology textbooks. Please be considerate of your classmates and remember to logoff after reading, downloading or printing the content for personal study.

Instructors will direct students to required reading selections from the following textbooks:
- Pulmonary Physiology 9e, Michael G. Levitzky. 2018.

Instructors will direct students to recommended reading selections from:

During the semester, instructors may make suggestions for optional readings and additional required readings in their lectures or course materials posted on OWL.

Contact with Instructors regarding course materials:
Students may approach and discuss any course-related problems with the relevant instructor. Please make an appointment (preferably via email) utilizing the contact information provided above.

Collaborative work:
Students are encouraged to work together, but each student must take total responsibility for their submitted work.

Note on Plagiarism: “Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence” (see Scholastic Offence Policy in the Western Academic Calendar).
5. Methods of Evaluation

**MEDBIO 3501A**

<table>
<thead>
<tr>
<th>Assessments</th>
<th>Dates</th>
<th>methods</th>
<th>Grade Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment #1</td>
<td>Sept 20 Due by noon</td>
<td>Short-answer</td>
<td>10</td>
</tr>
<tr>
<td>Assignment #2</td>
<td>Oct 11 Due by noon</td>
<td>Short-answer</td>
<td>10</td>
</tr>
<tr>
<td>Assignment #3</td>
<td>Nov 22 Due by noon</td>
<td>Short-answer</td>
<td>10</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>Oct 29</td>
<td>Short-answer and multiple-choice</td>
<td>30</td>
</tr>
<tr>
<td>Final Exam</td>
<td>University scheduled</td>
<td>Short-answer and multiple-choice</td>
<td>40</td>
</tr>
</tbody>
</table>

**BIOPHYS 9501A**

<table>
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<th>Dates</th>
<th>methods</th>
<th>Grade Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment #1</td>
<td>Sept 20 Due by noon</td>
<td>Short-answer</td>
<td>5</td>
</tr>
<tr>
<td>Assignment #2</td>
<td>Oct 11 Due by noon</td>
<td>Short-answer</td>
<td>5</td>
</tr>
<tr>
<td>Assignment #3</td>
<td>Nov 22 Due by noon</td>
<td>Short-answer</td>
<td>5</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>Oct 29</td>
<td>Short-answer and multiple-choice</td>
<td>15</td>
</tr>
<tr>
<td>Class Presentation</td>
<td>December 3, December 5</td>
<td>oral presentation; quality of visual materials and student notes; question and answers.</td>
<td>30</td>
</tr>
<tr>
<td>Final Exam</td>
<td>University scheduled</td>
<td>Short-answer and multiple-choice</td>
<td>40</td>
</tr>
</tbody>
</table>

**Assignments.** Students may work as individuals or in groups, however, each student shall submit their own assignment for grading. The assignments may involve calculations and short answer questions.

- Students will submit their assignments as single documents in *.pdf format on OWL for grading before the posted due dates. A 10% penalty per day will be assessed on all late submitted assignments or given a grade of zero if the assignment is not submitted by noon on the Monday before the scheduled Tutorial Assignment discussion.
- An extension for assignment submission which is delayed due to medical reasons, can only be granted by the Academic Counseling Office. Please see section 6C below for University Policies. Students are advised to inform the instructor as soon as possible regarding such delays.

**Examinations.** The midterm test and final exam will be in hand-written format. Exams will be composed of multiple-choice questions and short-answer questions requiring students to make calculations, and may include short “essay” questions. The only electronic devices permitted for use during the exams are standard (not programmable) calculators.

**For BIOPHYS 9501A only.** The combined weighting of the assignments and mid-term exam are reduced by half and replaced with a class presentation (topic to be assigned by instructor) weighted at 30% of the final grade. Graduate students will deliver a lecture during a classroom lecture period (50 minutes). Grading of the presentation will be based on the quality of the oral presentation and accompanying slides, written documents i.e. class lecture notes posted on OWL for other students, and ability to address questions.
6. Additional Information/Statements

A. Statement on Use of Electronic Devices
The only electronic devices permitted for use during tests and exams are standard (not programmable) calculators. Use of mobile phones in class, or during tests and exams is not permitted under any circumstances.

B. Statement on Academic Offences
Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

C. Accommodation for Illness
For University Policy on Accommodation for Illness see:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf

For a downloadable student medical certificate see:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

Students seeking academic accommodation on illness grounds for any missed tests, exams, participation components and/or assignments worth 10% or more of their final grade must apply to the Academic Counselling office of their home Faculty and provide documentation. The instructor or department cannot grant academic accommodation.

D. Special Examinations
A Special Examination must be written at the University or an Affiliated University College no later than 30 days after the end of the examination period involved. To accommodate unusual circumstances, a date later than this may be arranged at the time permission is first given by the Dean of the Faculty. The Dean will consult with the instructor and Department Chair and, if a later date is arranged, will communicate this to Registrarial Services. If a student fails to write a scheduled Special Examination, permission to write another Special Examination will be granted only with the permission of the Dean in exceptional circumstances and with appropriate supporting documents. In such a case, the date of this Special Examination normally will be the scheduled date for the final exam the next time the course is offered.

E. Support Services
Office of the Registrar: http://www.registrar.uwo.ca

Accessibility: http://accessibility.uwo.ca/resources/support_services.html

Student Center: http://student.uwo.ca

Student Development Centre: http://www.sdc.uwo.ca

Wellness Education Centre: http://www.shs.uwo.ca/

Students that are in emotional/mental distress should refer to Student Health Services https://www.uwo.ca/health/shs/index.html for a complete list of options about how to obtain help.