COURSE DETAILS

<table>
<thead>
<tr>
<th>Units of Credit</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact hours</td>
<td>4 hours per week</td>
</tr>
<tr>
<td>Lecture</td>
<td>Wednesday, 10:00 – 12:00 Mathews Theatre D (D23)</td>
</tr>
</tbody>
</table>
| Computer Laboratories | Wednesday, 13:00 – 15:00 Room 518, Level 5, Samuels Bldg (F25)  
                               Thursday, 14:00 – 16:00 Room 518, Level 5, Samuels Bldg (F25) |
| Course Coordinator | A/Prof Socrates Dokos  
                      email: s.dokos@unsw.edu.au  
                      office: Room 506, Samuels Bldg  
                      phone: 9385 9406 |
| Co-Coordinator   | Dr Michael Stevens  
                      email: michael.stevens@unsw.edu.au  
                      office: Room LG10, Samuels Bldg  
                      phone: 9385 3912 |
| Guest Lecturer   | Prof Albert Avolio  
                      email: alberto.avolio@mq.edu.au |
| Demonstrators    | Mr Luke Sy  
                      email: l.sy@unsw.edu.au  
                      Mr Keith Ly  
                      email: keith.ly@unsw.edu.au  
                      Mr Amin Hassanzadehbarforoushi  
                      email: a.hassanzadehbarforoushi@unsw.edu.au |

INFORMATION ABOUT THE COURSE

Welcome to BIOM9701: Dynamics of the Cardiovascular System. This course deals primarily with the physical and mechanical principles by which the cardiovascular system functions: as targeted by numerous biomedical devices and applications. It will teach you the appropriate theory to analyse blood flow quantitatively throughout all parts of the cardiovascular system, as well as cardiac function itself. The principles are mainly fluid-mechanical, but use is made of analogies to electrical transmission lines. You will also experience examples of how mathematical modelling can be applied to this biological system to achieve insights which would be unlikely otherwise.

Lecture notes will be available on-line via Moodle, along with weekly pre-class activities, in-class exercises and post-class homework assignments.

This is an introductory subject. However, in order to cover the material necessary to give you adequate skills, you will be required to devote significant amounts of time to reading lecture and reference materials, and to performing the prescribed pre-class and assignment tasks.

Computer laboratories will be held in the Graduate School of Biomedical Engineering (GSBmE) Green Room, room 518, using the Windows operating system and Matlab mathematical software. The computer laboratory will be accessible using a swipe card system based on your student card (the same system that will give you access to the building and the lifts).

This course is largely a standalone subject within GSBmE, serving as an introduction to cardiac biophysics and the mechanics of the Circulation. Some mathematical modelling principles taught in the course are covered in greater detail in BIOM9711 Modelling Organs, Tissues and Devices.
Additional biomechanical principles are also covered in BIOM9510 Introductory Biomechanics, BIOM9561 Mechanics of Biomaterials, BIOM9541 Mechanics of the Human Body, SESC9451 Experimental Biomechanics and BIOM9551 Biomechanics of Physical Rehabilitation.

We hope you find this course enjoyable, and a catalyst for further learning in the important and fascinating field of cardiovascular dynamics!

**HANDBOOK DESCRIPTION**

See link to virtual handbook: 

**OBJECTIVES**

This course provides an overview of the electrical and mechanical principles of the cardiovascular system, aiming to teach how the appropriate equations of physics and engineering can be used to analyse cardiac function and blood flow quantitatively in all the parts of the cardiovascular system. Students will also learn how mathematical modelling can be applied to this biological system to achieve even further insights.

The assessment strategy consisting of weekly pre-class exercises and in-class group activities, weekly homework assignments and a final exam, will help foster the following UNSW Engineering graduate attributes:

- The skills involved in scholarly enquiry (through the group activities and assignments)
- An in-depth engagement with the relevant disciplinary knowledge in its inter-disciplinary context (through the pre-class exercises, team-based learning activities and homework assignments)
- Capacity for analytical and critical thinking and for creative problem solving (assessed through pre-class exercises, team-based learning activities, homework assignments and the final exam)
- Ability to engage in independent and reflective learning (via the pre-class exercises, team-based learning activities and homework assignments)

**TEACHING STRATEGIES**

This course will be taught via weekly lectures, team-based learning activities, pre-class activities and homework assignments. Students will be expected to apply theory covered in lectures weekly to the team-based learning activities and homework assignments. Assessments and feedback will be regularly provided to the students.

Experience suggests that students learn cardiovascular dynamics effectively via participation in class discussions, problem solving exercises and computer modelling. Hence, a large proportion of this course is dedicated to pre-class and team-based learning activities. Feedback provided by laboratory demonstrators is important in teaching correct understanding of theoretical principles.

The following table provides examples of learning approaches highly recommended for this course:

<table>
<thead>
<tr>
<th>Private Study</th>
<th>Lectures</th>
<th>Computer Laboratory</th>
<th>Homework Assignments</th>
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</thead>
<tbody>
<tr>
<td>Review lecture material.</td>
<td>Find out what you must learn.</td>
<td>Work through the weekly team-based learning activities, both the individual and group-based assessments.</td>
<td>Demonstrate higher understanding and problem solving.</td>
</tr>
<tr>
<td>Implement example Matlab code from the lectures and Moodle modules. Make sure you understand the code, even if you are familiar with Matlab.</td>
<td>Hear announcements on course changes.</td>
<td>Work through set weekly class-exercises.</td>
<td></td>
</tr>
<tr>
<td>Complete the weekly pre-class exercises and arrive prepared to each lab class.</td>
<td>Ask questions.</td>
<td>Ask questions.</td>
<td></td>
</tr>
<tr>
<td>Complete homework assignments.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keep up with notices and find out marks via Moodle.</td>
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</table>
EXPECTED LEARNING OUTCOMES

By the end of this course, you will be able to:

- relate the fundamental principles of cardiac mechanics and electrophysiology to normal and abnormal cardiovascular function.
- deconstruct the fundamental principles underlying pulsatile blood pressure and flow.
- explain the physiological function of the microcirculation and the effects of arterial branching on blood flow and pressure.
- describe the features of venous blood flow and the principles of autonomic and humoral regulation of the cardiovascular system.
- discover how medical devices are used to measure cardiovascular variables and to treat various cardiovascular pathologies.
- implement and solve mathematical models of the cardiovascular system numerically using MATLAB software.

For each hour of contact, it is expected that you will put in at least 1.5 hours of private study. You will need to spend substantial time in the computer laboratory or at home implementing computer-based assignments in Matlab.

ASSESSMENT

The assessment scheme for the course will be:

Weekly pre-class exercises and team-based learning activities (8) 20%
Homework Assignments (6) 20%
Final Exam 60%

Details of each assessment component are set out below:

PRE-CLASS EXERCISES, GROUP ACTIVITIES AND ASSIGNMENTS

Each week, pre-class exercises will be posted on Moodle to help you prepare for the team-based learning activities in the computer laboratory. You will be required to answer these questions on-line prior to each week’s lecture. During the computer laboratory class itself, you will be given an individual test under exam conditions (30 minutes), followed by an opportunity to confer with members of your allotted class group and post a revised answer to the same exercises (another 30 minutes). Your team-based learning mark for that week will consist of the averaged marks between your individual submission and your submission following group discussion. The remainder of the laboratory class will consist of further group submissions and following through with worked problems. This latter class work is not assessable. Throughout the course will also be given various homework assignments (6 assignments in total), due Monday 11:55 pm on either the following week or the week after. Note that late submission of assignments will incur a penalty deduction of 20% per day.

COURSE PROGRAM

The program of lecture topics is as follows:

TERM 1, 2020

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19-2-2020</td>
<td>Overview of the Heart and Circulation</td>
<td>Socrates Dokos</td>
</tr>
<tr>
<td>2</td>
<td>26-2-2020</td>
<td>Cardiac Electrophysiology</td>
<td>Socrates Dokos</td>
</tr>
<tr>
<td>3</td>
<td>4-3-2020</td>
<td>Cardiac Mechanics</td>
<td>Socrates Dokos</td>
</tr>
<tr>
<td>4</td>
<td>11-3-2020</td>
<td>Blood Flow in Arteries</td>
<td>Michael Stevens</td>
</tr>
<tr>
<td>5</td>
<td>18-3-2020</td>
<td>Wave Propagation in Blood Vessels</td>
<td>Socrates Dokos</td>
</tr>
<tr>
<td>6</td>
<td>25-3-2020</td>
<td>(No Lecture)</td>
<td>Socrates Dokos</td>
</tr>
<tr>
<td>7</td>
<td>1-4-2020</td>
<td>Blood Flow in Veins and the Microcirculation</td>
<td>Michael Stevens</td>
</tr>
<tr>
<td>8</td>
<td>8-4-2020</td>
<td>Heart Assist Devices</td>
<td>Michael Stevens</td>
</tr>
<tr>
<td>9</td>
<td>15-4-2020</td>
<td>Regulation of the Cardiovascular System</td>
<td>Michael Stevens</td>
</tr>
<tr>
<td>10</td>
<td>22-4-2020</td>
<td>Biomedical Engineering Applications of Cardiovascular Dynamics</td>
<td>Albert Avolio</td>
</tr>
</tbody>
</table>
RELEVANT RESOURCES

- **Recommended textbooks:**
  - Cardiovascular physiology, by Robert M. Berne and Matthew N. Levy (St. Louis: Mosby, 2001).

- **Recommended on-line software tutorials:**
  - a downloadable pdf chapter on solving systems of ordinary differential equations (ODEs) using Matlab, from the text Numerical Computing with Matlab, by Cleve Moler, is at [www.mathworks.com/moler/odes.pdf](http://www.mathworks.com/moler/odes.pdf)
  - Matlab Introduction (GSBmE) Moodle module

COURSE EVALUATION AND DEVELOPMENT

Student feedback has helped to shape and develop this course, including feedback obtained from on-line evaluations as part of UNSW’s as part of UNSW’s myExperience process. You are highly encouraged to complete such an on-line evaluation toward the end of Session. Feedback and suggestions provided will be important in improving the course for future students. Changes to the course from previous comments received have included more hands-on model examples in lectures and in the laboratories.

DATES TO NOTE

Refer to MyUNSW for Important Dates, available at: [https://my.unsw.edu.au/student/resources/KeyDates.html](https://my.unsw.edu.au/student/resources/KeyDates.html)

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise will have their names entered on a plagiarism register and will be liable to disciplinary action, including exclusion from enrolment.

It is expected that all students must at all times submit their own work for assessment. Submitting the work or ideas of someone else without clearly acknowledging the source of borrowed material or ideas is plagiarism.

Plagiarism is the use of another person’s work or ideas as if they were your own. When it is necessary or desirable to use other people’s material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at: [https://student.unsw.edu.au/plagiarism](https://student.unsw.edu.au/plagiarism)

ACADEMIC ADVICE

For information about:
- Notes on assessments and plagiarism,
- Special Considerations,
- School Student Ethics Officer, and
- BESS