UNSW Course Outline

# BIOM9701 Dynamics of the Cardiovascular System - 2024

Published on the 30 Jan 2024

## General Course Information

**Course Code :** BIOM9701
**Year :** 2024
**Term :** Term 1
**Teaching Period :** T1
**Is a multi-term course? :** No
**Faculty :** Faculty of Engineering
**Academic Unit :** Graduate School of Biomedical Engineering
**Delivery Mode :** Multimodal
**Delivery Format :** Standard
**Delivery Location :** Kensington
**Campus :** Sydney
**Study Level :** Undergraduate, Postgraduate
**Units of Credit :** 6

**Useful Links**

Handbook Class Timetable

## Course Details & Outcomes

### Course Description

This course provides an overview of the cardiovascular system's electrical, mechanical and fluid flow principles, teaching how to apply the appropriate equations of physics and engineering to analyse cardiac function and blood flow quantitatively in all the parts of the cardiovascular

system. You will learn how mathematical modelling and engineering techniques can be applied to this physiological system to achieve even further insights.

## Course Aims

This course aims to provide an understanding of the electrical and mechanical principles by which the cardiovascular system functions, using mathematical modelling to analyse cardiac function and vascular blood flow in all parts of this system. Correct functioning of the heart and blood vessels is crucial to human health, with many medical devices targeting the cardiovascular system. A good understanding of the underlying electrical, mechanical, and modelling principles of this system is useful for many other courses in biomedical engineering, including physiology, biosensors and transducers, biomedical instrumentation, and computational modelling.

# Course Learning Outcomes

| Course Learning Outcomes |
|---|
| CLO1 : Describe the fundamental principles of cardiac mechanics and electrophysiology related to normal and abnormal cardiovascular function. |
| CLO2 : Explain the fundamental principles underlying pulsatile blood pressure and flow. |
| CLO3 : Explain the physiological function of the microcirculation and the effects of arterial branching on blood flow and pressure. |
| CLO4 : Describe the features of venous blood flow and the principles of autonomic and humoral regulation of the cardiovascular system. |
| CLO5 : Explain how medical devices are used to measure cardiovascular variables and treat various cardiovascular pathologies. |
| CLO6 : Implement and solve mathematical models of the cardiovascular system numerically using MATLAB software. |

| Course Learning Outcomes | Assessment Item |
|---|---|
| CLO1 : Describe the fundamental principles of cardiac mechanics and electrophysiology related to normal and abnormal cardiovascular function. | • Online Quizzes<br>• Assignments<br>• Final exam |
| CLO2 : Explain the fundamental principles underlying pulsatile blood pressure and flow. | • Online Quizzes<br>• Assignments<br>• Final exam |
| CLO3 : Explain the physiological function of the microcirculation and the effects of arterial branching on blood flow and pressure. | • Online Quizzes<br>• Assignments<br>• Final exam |
| CLO4 : Describe the features of venous blood flow and the principles of autonomic and humoral regulation of the cardiovascular system. | • Online Quizzes<br>• Assignments<br>• Final exam |
| CLO5 : Explain how medical devices are used to measure cardiovascular variables and treat various cardiovascular pathologies. | • Online Quizzes<br>• Assignments |
| CLO6 : Implement and solve mathematical models of the cardiovascular system numerically using MATLAB software. | • Online Quizzes<br>• Assignments |

# Learning and Teaching Technologies

Moodle - Learning Management System | Blackboard Collaborate | Microsoft Teams

# Learning and Teaching in this course

Moodle will be used to submit assignments, watch lectures and review content.

Collaborate will be used for online consultation sessions and the final exam.

Teams will be used only if necessary and you will be notified when that will occur.

## Additional Course Information

Pre-class activities, group activities and assignments

Each week, pre-class activities 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 online prior to each week's laboratory class. 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 15 minutes). Your team-based learning mark for that week will consist of the sum of 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 classwork is not assessable.

Throughout the course, you 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.

All lectures each week will be pre-recorded: you may watch this lecture at any time of your convenience prior to your scheduled weekly laboratory class (Thursdays).

Every week, Tuesday 5-6 pm (i.e. in the latter half of the scheduled weekly lecture slot), there will be a 1 hour online consultancy session where students can ask questions related to lectures, assignments, or other course content.

Learning approaches

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

Private Study

- Watch the online lecture.
- Complete the weekly pre-class activity and arrive prepared for each lab class.
- Implement example Matlab code from the lectures and Moodle modules. Make sure you understand the code, even if you are familiar with Matlab.
- Attend the weekly consultancy session if you have any questions related to the course.

- Complete homework assignments.

Computer Laboratory

- Work through the weekly team-based learning activities, both the individual and group-based assessments.
- Work through set weekly class exercises.
- Ask questions.

Homework Assignments

- Allocate enough time to complete these and submit them by the due date.

# Assessments

## Assessment Structure

| Assessment Item | Weight | Relevant Dates |
|---|---|---|
| Online Quizzes<br>Assessment Format: Individual | 20% | Start Date: Not Applicable<br>Due Date: Not Applicable |
| Assignments<br>Assessment Format: Individual | 30% | |
| Final exam<br>Assessment Format: Individual | 50% | |

## Assessment Details

### Online Quizzes

**Assessment Overview**

This assessment consists of a series of quizzes, given during the weekly laboratory class. The quizzes will consist of online multiple-choice questions and are designed to encourage learning throughout the semester. Quizzes must be attempted during the laboratory class and will consist of an individual-based test (known as an individual readiness assurance test, or IRAT) and a team-based test (referred to as a team readiness assurance test, or TRAT). Students will need to prepare by revising the lecture for that week. Feedback will be immediately provided to students in class on completion of the TRAT component.

**Course Learning Outcomes**

- CLO1 : Describe the fundamental principles of cardiac mechanics and electrophysiology related to normal and abnormal cardiovascular function.
- CLO2 : Explain the fundamental principles underlying pulsatile blood pressure and flow.
- CLO3 : Explain the physiological function of the microcirculation and the effects of arterial branching on blood flow and pressure.

- CLO4 : Describe the features of venous blood flow and the principles of autonomic and humoral regulation of the cardiovascular system.
- CLO5 : Explain how medical devices are used to measure cardiovascular variables and treat various cardiovascular pathologies.
- CLO6 : Implement and solve mathematical models of the cardiovascular system numerically using MATLAB software.

Assessment information

Each week, a pre-class activity will be posted on Moodle to help you prepare for the team-based learning activities in the computer laboratory. 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 15 minutes). Your team-based learning mark for that week will consist of the sum of your individual submission and your group submission.

## Assignments

Assessment Overview

This assessment consists of 6 submissions, where students are required to solve problems in cardiovascular dynamics typically using Matlab software. Feedback to students will be provided online around 1 week after each submission.

Course Learning Outcomes

- CLO1 : Describe the fundamental principles of cardiac mechanics and electrophysiology related to normal and abnormal cardiovascular function.
- CLO2 : Explain the fundamental principles underlying pulsatile blood pressure and flow.
- CLO3 : Explain the physiological function of the microcirculation and the effects of arterial branching on blood flow and pressure.
- CLO4 : Describe the features of venous blood flow and the principles of autonomic and humoral regulation of the cardiovascular system.
- CLO5 : Explain how medical devices are used to measure cardiovascular variables and treat various cardiovascular pathologies.
- CLO6 : Implement and solve mathematical models of the cardiovascular system numerically using MATLAB software.

Assessment information

Late submission of these assignments will incur a penalty deduction of 20% per day.

## Final exam

Assessment Overview

This assessment constitutes the final exam for the course. It will be an online and open-book

exam consisting of calculation-type and Matlab-programming questions. Students will need to prepare by studying the course lecture notes, weekly quizzes, and in-class weekly problems. Feedback will be provided to students in Moodle on completion of marking.

Course Learning Outcomes

- CLO1 : Describe the fundamental principles of cardiac mechanics and electrophysiology related to normal and abnormal cardiovascular function.
- CLO2 : Explain the fundamental principles underlying pulsatile blood pressure and flow.
- CLO3 : Explain the physiological function of the microcirculation and the effects of arterial branching on blood flow and pressure.
- CLO4 : Describe the features of venous blood flow and the principles of autonomic and humoral regulation of the cardiovascular system.

## General Assessment Information

Grading Basis

Standard

# Course Schedule

## Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

## General Schedule Information

Each week, you will have to complete the following tasks:

1. Watch the online lecture content before the face to face lab class.

2. (Optional) - Attend the online consultation Tuesday 5-6 pm to ask questions.

3. Complete the pre-class H5P lesson and associated questions.

4. Attend the weekly lab classes (either 12-2 or 4-6 pm Thursdays) and participate in the IRAT and TRAT questions.

5. Work on your MATLAB assignments (there are 6 to complete throughout the term).

# Course Resources

## Recommended Resources

Textbooks

- Biomechanics: Circulation, by Y.C. Fung (New York: Springer, 1996). Note, an earlier edition by the same author - Biodynamics: Circulation (New York: Springer-Verlag, 1984) - is available in the library.
- McDonald's blood flow in arteries: theoretic, experimental and clinical principles, edited by Wilmer W. Nichols and Michael F. O'Rourke (London: Edward Arnold, 1990).
- Cardiovascular physiology, by Robert M. Berne and Matthew N. Levy (St. Louis: Mosby, 2001).
- Biofluid mechanics: the human circulation, by Krishnan B. Chandran, Stanley E. Rittgers, and Ajit P. Yoganathan (Boca Raton: CRC/Taylor & Francis, 2007).

Online Tutorials

- On-line Matlab tutorials and courses from Mathworks, Inc can be accessed from https://au.mathworks.com/academia/tah-portal/university-of-new-south-wales-341489.html

## 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.

# Staff Details

| Position | Name | Email | Location | Phone | Availability | Equitable Learning Services Contact | Primary Contact |
|---|---|---|---|---|---|---|---|
| Convenor | Socrates Dokos | | Rm 506, Samuels Building (F25) | 9385 9406 | Mondays 1-2 pm (online). Appointments can also be made via e-mail. | No | No |
| Lecturer | Michael S tevens | | Rm 1005, Biological Sciences South Building (E26) | 9385 2891 | Mondays 1-2 pm (online). Appointments can also be made via e-mail. | No | Yes |
| Demonstrator | Laurence Boss | | | | | No | No |
| | Corina Di ng | | | | | No | No |

# Other Useful Information

### Academic Information

#### I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with

your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

**II. Administrative matters and links**

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

**III. Equity and diversity**

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

**IV. Professional Outcomes and Program Design**

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

*Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date*

*class descriptions.  If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/ Moodle/LMS applies.*

## Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

## Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the

assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

## Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

**Phone**

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

## School Contact Information

Student Services can be contacted via unsw.to/webforms.