

BIOM9650

Biosensors and Transducers

Term 1, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Thanh Nho Do	tn.do@unsw.edu.au		Room 1003, Level 1, E26 Biological Sciences South	

Lecturers

Name	Email	Availability	Location	Phone
Nigel Lovell	n.lovell@unsw.edu.au			
David Tsai	d.tsai@unsw.edu.au			

Demonstrators

Name	Email	Availability	Location	Phone
Heba Khamis	h.khamis@unsw.edu.au			
James Davies	j.j.davies@student.unsw.edu.au			
Phuoc Thien Phan	phuoc_thien.phan@unsw.edu.au			
Trung Thien Hoang	trungthien.hoang@unsw.edu.au			
Mai Thanh Thai	maithanh.thai@unsw.edu.au			
Reem Almasri	r.almasri@unsw.edu.au			

School Contact Information

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

Course Details

Units of Credit 6

Summary of the Course

This course serves as an introduction to physiological measurement using biosensors and transducers. This course deals primarily with gaining an understanding of the physical principles which govern the measurement of a biological variable or system, by a transducer which converts the variable into an electrical signal. By the end of the course you should understand various measurement devices and approaches including the underlying biological process that generates the quantity to be measured or controlled. The basic biosensors and transducers used to measure pressure, flow, volume and kinematics are examined along with aspects of electrical safety and imaging instrumentation.

Course Aims

The aims of this course are to:

1. introduce the student to different sensor applications in biomedical instrumentation;
2. impart an understanding of the mechanisms which govern the acquisition and processing of physiological signals recorded from a human subject, both in vivo and in vitro;
3. empower the student to critically evaluate sensor and transducer options for a particular biomedical application.

Course Learning Outcomes

1. Describe the applications of various sensors and transducers available for physiological and cellular measurements
2. Explain fundamental biosensing and transduction principles
3. Apply electrical, mechanical and chemical engineering concepts to a range of problems and medical applications
4. Compute simple biosensing and transduction problems
5. review the literature in the biosensing and transduction application area

Graduate capabilities

These learning outcomes relate most strongly to the following UNSW graduate outcomes:

1. **scholarly enquiry capable of independent and collaborative enquiry;**
2. **understanding of their discipline in its interdisciplinary context;**
3. **able to apply their knowledge and skills to solving problems, and;**
4. **collaborative and effective team workers.**

Teaching Strategies

Teaching strategies

This course consists of integrated lecture, tutorial and practical work. For the first six weeks of the semester there will be a three hour period, which will include a lecture and small group exercises/tutorials, group discussions and other methods to facilitate student learning. Alternate lecture weeks will be followed up with homework assignments, which students will take away and solve and submit the following week for assessment. These will contribute towards the final course mark.

There will be a quiz assessment (mid-semester quiz) in Week 7 contributing to the final mark. This will assist with solidifying the theory and content covered in the earlier weeks, before the laboratory sessions start in the following weeks.

From Week 8 to Week 10, a set of laboratory experiments will be conducted to help develop a practical and intuitive understanding of a selection of sensors types.

A final extended revision tutorial will be given in Week 12 (exact date will be updated later), in advance of the final assessment.

Additional Course Information

Presumed knowledge

A good background in mathematics and physics is essential. Basic knowledge of chemistry is assumed. Some knowledge of electrical engineering would also be extremely advantageous, although the basics will be covered in the early lectures. The MATLAB programming environment will be used in the laboratories and as part of some homework exercise, so familiarity with MATLAB or some other programming language will be helpful; if you enrol in this course, an additional Moodle module will be made available to you which contains some MATLAB tutorial material, videos and quizzes to help bring you up to speed.

How this course relates to other courses

"BIOM9640: Biomedical Instrumentation" is a complementary course to BIOM9650, and deals with the genesis of electrical biosignals in the body and how to design measurement electronics to record these signals, which are robust against noise. It is not necessary to have completed BIOM9640 to take BIOM9650, but the background knowledge in mathematics, electrical engineering, and amplification provided by BIOM9640 will be beneficial. However, some introductory electrical engineering topics will also be revised in the first lecture of BIOM9650.

"BIOM9660: Implantable Bionics", is also related to this course and expands on aspects of bioelectrodes, biopotentials and neural stimulation from the perspective of designing and manufacturing an implantable therapeutic device.

"BIOM9711: Modelling Organs, Tissues and Devices" provides a practical overview of computational modelling in bioengineering, focusing on a range of applications including electrical stimulation of neural and cardiac tissues. The knowledge gained in BIOM9650 will assist in understanding these processes.

"BIOM9621: Biological Signal Analysis", provides an understanding of linear systems and signals and knowledge of these topics is useful for understanding the response and limitations of biosensors and transducers.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Laboratory Attendance	10%	1 week from the start date	1, 2, 3
2. Mid Semester Quiz	20%	Not Applicable	1, 2
3. Homework Questions	15%	1 week from the start date	1, 2, 3
4. Final Exam	40%	Not Applicable	1, 2, 3
5. Major Laboratory Report	15%	1 week from the start date	1, 4

Assessment 1: Laboratory Attendance

Start date: 05/04/2022 09:00 AM

Due date: 1 week from the start date

Students have to attend the labs

This is not a Turnitin assignment

Assessment 2: Mid Semester Quiz

Start date: 01/04/2021 09:00 AM

Assessment length: 2 hours

Mid Semester Quiz

This is not a Turnitin assignment

Assessment 3: Homework Questions

Start date: 18/02/2021 06:50 PM

Due date: 1 week from the start date

Homework Questions

This is not a Turnitin assignment

Additional details

1. Homework Assignment 1: Displacement	issued on: 17th Feb	due on: 24th Feb
2. Homework Assignment 2: Flow	issued on: 24th Feb	due on: 3th Mar
3. Homework Assignment 3: Volume	issued on: 3th Mar	due on: 10th Mar
4. Homework Assignment 4: Pressure	issued on: 10th Mar	due on: 17th Mar

5. Homework Assignment 5: Light

issued on: 17th Mar

due on: 5th Apr

Assessment 4: Final Exam

Start date: The start date will be determined later

Assessment length: 3 hours

Final Exam

Assessment 5: Major Laboratory Report

Start date: 06/04/2021 06:48 PM

Due date: 1 week from the start date

Major Laboratory Report

This is not a Turnitin assignment

Attendance Requirements

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

Course Schedule

[View class timetable](#)

Timetable

Date	Type	Content			
Week 1: 14 February - 18 February	Lecture	Week	Date	Topic	Lecturer
		1	18th Feb	Measuring Displacement & Position	Thanh Nho Do
Week 2: 21 February - 25 February	Lecture	Week	Date	Topic	Lecturer
		2	24th Feb	Measuring Flow	Thanh Nho Do
Week 3: 28 February - 4 March	Lecture	Week	Date	Topic	Lecturer
		3	3th Mar	Measuring Volume	Nigel Lovell
Week 4: 7 March - 11 March	Lecture	Week	Date	Topic	Lecturer
		4	10th Mar	Measuring Pressure	Thanh Nho Do
Week 5: 14 March - 18 March	Lecture	Week	Date	Topic	Lecturer
		5	17th Mar	Measuring Light	David Tsai
Week 6: 21 March - 25 March	Lecture	Week	Date	Topic	Lecturer
		6	24th Mar	Flexible Week	
Week 7: 28 March - 1 April	Assessment	Week	Date	Topic	Lecturer
		7	31st March	MID-SEMESTER QUIZ	Thanh Nho Do
Week 8: 4 April - 8 April	Tut-Lab	Week	Date	Topic	Lecturer
		8	Starting 5th Apr	LAB	-

Week 9: 11 April - 15 April	Tut-Lab	Week	Date	Topic	Lecturer
		9	Starting 12th Apr	LAB	-
Week 10: 18 April - 22 April	Tut-Lab	Week	Date	Topic	Lecturer
		10	Starting 19th Apr	LAB	-

Resources

Prescribed Resources

Online course material can be accessed through Moodle, which is managed by the UNSW Technology Enabled Learning and Teaching unit: <https://moodle.telt.unsw.edu.au>. Once you are enrolled in the course, BIOM9650 will be visible to you after the session starts, when you log into Moodle using your zPass.

Tutorial tasks, group discussions, lecture notes and resource materials will be made available on this site during session. Announcements made on Moodle will be forwarded to your student email; you are required to check your student email frequently for updates.

Some useful reference books that are held in the UNSW Library are:

- *Medical Instrumentation – Application and Design*, edited by J.G. Webster (Wiley, 4th ed., 2010).
- *Introduction to Biomedical Engineering*, edited by J. D. Enderle, J. D. Bronzino. (Academic Press (Elsevier) 3rd ed., 2011).
- *Biomedical Transducers and Instruments*, T. Togawa, T. Tamura and P.Å. Öberg (CRC Press, 2nd ed., 2011).
- *The Art of Electronics - Paul Horowitz* (Winfield Hill, 3rd ed., 2015).

Course Evaluation and Development

Student feedback on the course and the lecturers in the course is gathered at the end of each session using the university's *MyExperience* survey. Your feedback is much appreciated and taken very seriously. Furthermore, **your feedback is completely anonymous**; while lecturers can see an aggregated view of student responses, and can read your comments, they cannot see who provided the feedback. Continual improvements are made to the course based in part on such feedback, and this helps us to improve the course for future students.

Submission of Assessment Tasks

Laboratory reports and major assignments will require a [Non Plagiarism Declaration Cover Sheet](#).

Assignments should be submitted on time. A daily penalty of 5% of the marks available for that assignment will apply for work received after the due date. Any assignment more than 5 days late will not be accepted. The only exemption will be when prior permission for late submission has been granted by the Course coordinator. Extensions will be granted only on medical or compassionate grounds under extreme circumstances.

Academic Honesty and Plagiarism

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.

All assessments which you hand in must have a [Non Plagiarism Declaration Cover Sheet](#). This is for both individual and group work. Attach it to your assignment before submitting it to the Course Coordinator or at the School Office.

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>

Academic Information

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 Term. Feedback and suggestions provided will be important in improving the course for future students.

DATES TO NOTE

Refer to MyUNSW for Important Dates, available at:
<https://my.unsw.edu.au/student/resources/KeyDates.html>

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism,
- Special Considerations,
- School Student Ethics Officer, and
- BESS

refer to the School website available at
<http://www.engineering.unsw.edu.au/biomedical-engineering/>

Supplementary Examinations:

Supplementary Examinations for Term 1 2022 will be held on (TBC) should you be required to sit one.

Image Credit

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Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.