BIOM9650

Biosensors and Transducers

Term 1, 2023

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
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Demonstrators

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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 medical 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 four 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 in Week 7contributing 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 5 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 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

There will be hand-in homework assignments, a mid-session quiz, and a major laboratory report. There will also be a final examination consisting of both qualitative and quantitative long-answer questions. In addition, your attendance and completeness of your laboratory notebook will also be assessed. The following criteria will be applied in assessing your work:

- evidence of critical understanding of the concepts developed in the course;
- ability to apply these concepts to a range of bioinstrumentation problems;
- clarity of description, explanation and attention to the focus of the assessment task;
- degree to which the material submitted for assessment addresses the specified requirements.

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%	05/05/2023 11:59 PM	1, 4

Assessment 1: Laboratory Attendance

Start date: 14/03/2023 10:00 AM
Due date: 1 week from the start date

It is expected that students will attend all laboratory classes and document results and discussion in a formal laboratory book. This book will be marked each week (at the start of the lab for the analysis and discussion of the previous weeks experiments, and at the end of the lab for the raw data of the current weeks experiments) for completeness and consistency with a set of laboratory notebook guidelines that will be supplied to the student.

This assessment addresses learning outcomes: L1,L2,L3,L4,L5.

Related graduate capabilities: G1, G2, G3, G4.

This is not a Turnitin assignment

Assessment 2: Mid Semester Quiz

Start date: 28/03/2023 10:00 AM
Assessment length: 2 hours

A quiz is scheduled approximately half way through the session. It comprises a mix of discursive questions, derivations and calculations, in a format similar to the final exam. The aim of this assessment is to encourage student revision during the course and to allow students to gauge their progress in different topics and receive feedback on that progress.

This assessment addresses learning outcomes: L1,L2,L3,L4.

Related graduate capabilities: G2,G3.

This is not a Turnitin assignment

Assessment 3: Homework Questions

Start date: 14/02/2023 10:00 AM
Due date: 1 week from the start date

A major aspect of this course is problem solving. This entails choosing the appropriate model, implementing it correctly and arriving at the correct answer. To complete the homework questions, students will use fundamental material from the lectures and tutorials. Assignments should be submitted on time. Marks will be deducted for late submission without prior approval.

This assessment addresses learning outcomes: L1, L2, L3, L4,L5.

Related graduate capabilities: G1, G2, G3, G4.

This is not a Turnitin assignment

Additional details

1. Homework Assignment 1: Displacement	issued on: 14th Feb	due on: 21th Feb
2. Homework Assignment 2: Flow	issued on: 21th Feb	due on: 28th Feb
3. Homework Assignment 3: Volume	issued on: 28th Feb	due on: 7th Mar
4. Homework Assignment 4: Pressure	issued on: 7th Mar	due on: 14th Mar

Assessment 4: Final Exam

Start date: The start date will be determined later
Assessment length: 3 hours

The final exam will take a form similar to the mid-session quiz, consisting of a mix of discursive questions, derivations and calculations. The aim of this assessment is to encourage students to review the entire course, including laboratory work, and to allow students to apply all the knowledge disseminated to solve problems.

This assessment addresses learning outcomes: L1,L2,L3,L4.

Related graduate capabilities: G3.

Assessment 5: Major Laboratory Report

Start date: 14/03/2023 10:00 AM
Due date: 05/05/2023 11:59 PM

It is expected that students will attend all laboratory classes and document results and discussion in a formal laboratory book. This book will be marked each week (at the start of the lab for the analysis and discussion of the previous weeks experiments, and at the end of the lab for the raw data of the current weeks experiments) for completeness and consistency with a set of laboratory notebook guidelines that will be supplied to the student.

This assessment addresses learning outcomes: L1,L2,L3,L4,L5.

Related graduate capabilities: G1, G2, G3, G4.

This is not a Turnitin assignment

Attendance Requirements

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

Course Schedule

1. Homework Assignment 1: Displacement issued on: 14th Feb due on: 21th Feb

2. Homework Assignment 2: Flow issued on: 21th Feb due on: 28th Feb

3. Homework Assignment 3: Volume issued on: 28th Feb due on: 7th Mar

4. Homework Assignment 4: Pressure issued on: 7th Mar due on: 14th Mar

5. Lab Book Start from 14-Mar due on: 5th May

View class timetable

Timetable

Date	Type	Content
Week 1: 13 February - 17 February	Lecture	**Week** 1 | **Date** 14th Feb | **Topic** Measuring Displacement | **Lecturer** Thanh Nho Do
Week 2: 20 February - 24 February	Lecture	**Week** 2 | **Date** 21st Feb | **Topic** Measuring Flow | **Lecturer** Thanh Nho Do
Week 3: 27 February - 3 March	Lecture	**Week** 3 | **Date** 28th Feb | **Topic** Measuring Volume | **Lecturer** Nigel Lovell
Week 4: 6 March - 10 March	Lecture	**Week** 4 | **Date** 7th Mar | **Topic** Measuring Pressure | **Lecturer** Thanh Nho Do
Week 5: 13 March - 17 March	Laboratory	**Week** 5 | **Date** Starting 14th Mar | **Topic** *LAB* | **Lecturer** Thanh Nho Do
Week 6: 20 March - 24 March	Lecture	**Week** 6 | **Date** Starting | **Topic** Flexible Week with | **Lecturer**

		20th Mar | Tutorials including Q&A for mid-term exam |
Week 7: 27 March - 31 March	Assessment	**Week** | **Date** | **Topic** | **Lecturer** 7 | 28th March | *MID-SEMESTER QUIZ* | Thanh Nho Do
Week 8: 3 April - 7 April	Laboratory	**Week** | **Date** | **Topic** | **Lecturer** 8 | Starting 4th Apr | *LAB* | Thanh Nho Do
Week 9: 10 April - 14 April	Laboratory	**Week** | **Date** | **Topic** | **Lecturer** 9 | Starting 11th Apr | *LAB* | Thanh Nho Do
Week 10: 17 April - 21 April	Laboratory	**Week** | **Date** | **Topic** | **Lecturer** 10 | Starting 18th Apr | *LAB* | Thanh Nho Do

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 2023 will be held on (TBC) should you be required to sit one.

This course outline sets out 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 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 (as updated in Moodle), the description in the Course Outline/Moodle applies.

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.