BIOM9650
Biosensors and Transducers

Term One // 2021
Course Overview

Staff Contact Details

Convenors

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Availability</th>
<th>Location</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thanh Nho Do</td>
<td><a href="mailto:tn.do@unsw.edu.au">tn.do@unsw.edu.au</a></td>
<td></td>
<td>Room 1003, Level 1, E26 Biological Sciences</td>
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<td>South</td>
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Lecturers

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<th>Email</th>
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<tbody>
<tr>
<td>Nigel Lovell</td>
<td><a href="mailto:n.lovell@unsw.edu.au">n.lovell@unsw.edu.au</a></td>
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<tr>
<td>David Tsai</td>
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<tr>
<td>Jeff Armistead</td>
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Demonstrators

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<tr>
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<th>Location</th>
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<tbody>
<tr>
<td>Heba Khamis</td>
<td><a href="mailto:h.khamis@unsw.edu.au">h.khamis@unsw.edu.au</a></td>
<td></td>
<td></td>
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<tr>
<td>Harrison Low</td>
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<td></td>
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<td>Phuoc Thien Phan</td>
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<tr>
<td>Trung Thien Hoang</td>
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<td>Mai Thanh Thai</td>
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<td></td>
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<tr>
<td>Reem Almasri</td>
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School Contact Information

Student Services can be contacted via [unsw.to/webforms]().
Course Details

Credit Points 6

Summary of the Course

Welcome to “BIOM9650: Biosensors and Transducers”. This subject aims to impart an understanding of the physical principles which govern the measurement of a biological variable or system, using a transducer which converts the variable into an electrical signal. This course will principally focus on biosensors and transducers associated with measurement of physiological phenomena, including pressure, displacement, flow, volume and light. By the end of the course you should understand various measurement devices and techniques, including the underlying biological processes that generate the quantities to be measured or controlled. You should also be qualified to advise on the various sensing and transduction choices available to perform a given measurement and be aware of the associated advantages and disadvantages of each technique.

Course Aims

The aims of this course are to:

- introduce the student to different sensor applications in biomedical instrumentation;
- 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;
- 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 seven weeks of the semester there will be a three hour teaching period, which will include a lecture and tutorial, group discussions and other appropriate methods to facilitate student learning.

Weeks 1 to 6 (inclusive) will be followed up with homework assignments (six in total), 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 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. They are carried out both online (via Moodle) and face-to-face (at the lab)

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 Tasks

<table>
<thead>
<tr>
<th>Assessment task</th>
<th>Weight</th>
<th>Due Date</th>
<th>Student Learning Outcomes Assessed</th>
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</thead>
<tbody>
<tr>
<td>Laboratory Attendance</td>
<td>10%</td>
<td>1 week from the start date</td>
<td>1, 2, 3, 4, 5</td>
</tr>
<tr>
<td>Mid Semester Quiz</td>
<td>20%</td>
<td>Not Applicable</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>Homework Questions</td>
<td>15%</td>
<td>1 week from the start date</td>
<td>1, 2, 3, 4, 5</td>
</tr>
<tr>
<td>Final Exam</td>
<td>40%</td>
<td>Not Applicable</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>Major Laboratory Report</td>
<td>15%</td>
<td>1 week from the start date</td>
<td>1, 2, 3, 4, 5</td>
</tr>
</tbody>
</table>

Assessment Details

Assessment 1: Laboratory Attendance

Start date: 06/04/2021 09:00 AM

Details:

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.

Turnitin setting: This is not a Turnitin assignment

Assessment 2: Mid Semester Quiz

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

Length: 2 hours

Details:

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.

**Turnitin setting:** This is not a Turnitin assignment

**Assessment 3: Homework Questions**

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

**Details:**

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.

**Additional details:**

1. Homework Assignment 1: Displacement issued on: 18th Feb due on: 25th Feb
3. Homework Assignment 3: Volume issued on: 4th Mar due on: 11th Mar
4. Homework Assignment 4: Pressure issued on: 11th Mar due on: 18th Mar
5. Homework Assignment 5: Respiration issued on: 18th Mar due on: 25th Mar

**Turnitin setting:** This is not a Turnitin assignment

**Assessment 4: Final Exam**

**Start date:** The start date will be determined later

**Length:** 3 hours

**Details:**

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:** 06/04/2021 06:48 PM

**Details:**

This assessment is combined with the lab attendance:

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.

**Turnitin setting:** 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

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>Content</th>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Lecturer</th>
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</thead>
<tbody>
<tr>
<td>Week 1: 15 February - 19 February</td>
<td>Lecture</td>
<td></td>
<td>1</td>
<td>18th Feb</td>
<td>Measuring Displacement &amp; Position</td>
<td>Thanh Nho Do</td>
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<tr>
<td>Week 2: 22 February - 26 February</td>
<td>Lecture</td>
<td></td>
<td>2</td>
<td>25th Feb</td>
<td>Measuring Flow</td>
<td>Thanh Nho Do</td>
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<tr>
<td>Week 3: 1 March - 5 February</td>
<td>Lecture</td>
<td></td>
<td>3</td>
<td>4th Mar</td>
<td>Measuring Volume</td>
<td>Nigel Lovell</td>
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<tr>
<td>Week 4: 8 March - 12 March</td>
<td>Lecture</td>
<td></td>
<td>4</td>
<td>11th Mar</td>
<td>Measuring Pressure</td>
<td>Thanh Nho Do</td>
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<tr>
<td>Week 5: 15 March - 19 March</td>
<td>Lecture</td>
<td></td>
<td>5</td>
<td>18th Mar</td>
<td>Respiration</td>
<td>Jeff Armistead</td>
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<tr>
<td>Week 6: 22 March - 26 March</td>
<td>Lecture</td>
<td></td>
<td>6</td>
<td>25th Mar</td>
<td>Measuring Light</td>
<td>David Tsai</td>
</tr>
<tr>
<td>Week 7: 29 March - 2 April</td>
<td>Assessment</td>
<td></td>
<td>7</td>
<td>1st Apr</td>
<td>MID-SEMESTER QUIZ</td>
<td>Thanh Nho Do</td>
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<tr>
<td>Week 8: 5 April - 9 April</td>
<td>Tut-Lab</td>
<td></td>
<td>8</td>
<td>6th Apr</td>
<td>LAB</td>
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<table>
<thead>
<tr>
<th>Week 9: 12 April - 16 April</th>
<th>Tut-Lab</th>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Lecturer</th>
<th>Assessments Due</th>
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<tr>
<td></td>
<td></td>
<td>9</td>
<td>Starting 13th Apr</td>
<td>LAB</td>
<td>-</td>
<td>Lab book sign-off (analysis and discussion start of lab, raw data end of lab)</td>
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<table>
<thead>
<tr>
<th>Week 10: 19 April - 23 April</th>
<th>Tut-Lab</th>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Lecturer</th>
<th>Assessments Due</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>Starting 20th Apr</td>
<td>LAB</td>
<td>-</td>
<td>Lab book sign-off (analysis and discussion start of lab, raw data end of lab)</td>
</tr>
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</table>
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).**


- **Biomedical Transducers and Instruments, T. Togawa, T. Tamura and P.Å. Òberg (CRC Press, 2nd ed., 2011).**

- **The Art of Electronics - Paul Horowitz (Winfield Hill, 3rd ed., 2015).**

Recommended Resources

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.

Late submissions will be penalised 10% of the mark for each calendar day late. If you foresee a problem in meeting the nominated submission date please contact the Course Convenor to make an appointment to discuss your situation as soon as possible.
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 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 2021 will be held on Monday 24th May – Friday 28th May (inclusive) should you be required to sit one.

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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.