UNSW Course Outline

BIOM9610 Bioelectronics and Physiological Measurement - 2025

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General Course Information

Course Code : BIOM9610
Year : 2025
Term : Term 2
Teaching Period : T2
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 : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Electricity is everywhere in the human body. Electrical impulses make it possible for us to see, hear, stand up straight, and react to pain. A disruption in physiological electrical currents can lead to illness. This course will provide you with the essential knowledge required for bio-

electrodes, interfaces used to measure or control electrical signals within the human body. The course encompasses electric circuit theory and the biological mechanisms underlying electrical signals. Additionally, the course incorporates a practical component with multiple laboratory exercises covering topics in bioelectronics, programming, and bio-signal analytics and classification.

By the end of the course, you will have gained the skills and knowledge necessary to utilise various instruments, such as oscilloscopes and signal generators, for biomedical electronics. You will also acquire proficiency in using software tools like LabChart, PowerLab, and Matlab for programming, bio-signal acquisition, bio-signal/data analysis, and modelling techniques in simulating biological systems. Furthermore, you will develop an understanding of the mechanisms responsible for bioelectric signals that are measured or elicited in medical and clinical settings.

This course is designed for those without a background in programming, biological signal acquisition, and analysis, and is particularly recommended for individuals lacking experience in electrical or mechatronics engineering. Nonetheless, students from these two disciplines will gain first-hand experience collecting and analysing signals from the human body.

Course Aims

- Provide students with skills in using instrumentation/software to navigate advanced topics in bioelectronics.
- Expose students to the biological mechanisms underlying electrical signals in the human body, improving preparedness for courses in medical bioelectronics, instrumentations, medical sensors, and transducers.
- Enable students to acquire, process and analyse complex (electrical) recordings of biological data
- Enable students to identify the engineering equivalence of bioelectronics and biological signals and develop computational modelling skills to digitize physics and biology.

Relationship to Other Courses

This course serves as a gateway to the advanced courses in bioelectronics, instrumentations, medical sensors, and transducers:

- BIOM9640 Biomedical instrumentation
- BIOM9650 Biosensors and Transducers
- BIOM9660 Bionics and Neuromodulation

In addition, the skills and knowledge (electrical circuit concepts, MATLAB programming for biomedical engineers, biological signal collection and analyses, electrophysiology, and

computational modelling techniques) gained in this course form the foundation to other advanced courses related to computational modelling and/or bio-signal processing at Graduate School of Biomedical Engineering, as follows:

- BIOM9711 Modelling Organs, Tissues and Devices
- BIOM9621 Biological Signal Analysis

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain the electrophysiology underlying biological signals.
CLO2 : Explain and interpret electrical and software models of biological signals.
CLO3 : Evaluate the utility of instrumentation in measuring time-varying signals in biological applications.
CLO4 : Acquire complex recordings of biological data using contemporary technologies.
CLO5 : Process and analyse biological data using software engineering.
CLO6 : Express findings from literature and one's own work using written communication

Course Learning Outcomes	Assessment Item
CLO1 : Explain the electrophysiology underlying biological signals.	• Quizzes • Final exam
CLO2 : Explain and interpret electrical and software models of biological signals.	• Lab Assessments • Quizzes • Final exam
CLO3 : Evaluate the utility of instrumentation in measuring time-varying signals in biological applications.	• Lab Assessments • Quizzes
CLO4 : Acquire complex recordings of biological data using contemporary technologies.	• Lab Assessments
CLO5 : Process and analyse biological data using software engineering.	• Final exam • Lab Assessments • Quizzes
CLO6 : Express findings from literature and one's own work using written communication	• Lab Assessments

Learning and Teaching Technologies

Moodle - Learning Management System | Blackboard Collaborate | Microsoft Teams

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Lab Assessments Assessment Format: Individual	40%	Start Date: Not Applicable Due Date: Not Applicable
Quizzes Assessment Format: Individual	30%	Start Date: Not Applicable Due Date: Not Applicable
Final exam Assessment Format: Individual	30%	Start Date: Not Applicable Due Date: Not Applicable

Assessment Details

Lab Assessments

Assessment Overview

Four lab assessments (10% each) will be conducted throughout the term. They will integrate concepts from labs and lectures to evaluate student proficiency in synthesising key information, as well as their ability to apply knowledge to new and complex problems, overall requiring a deep comprehension of the lab skills relevant to bioelectronics and programming.

A rubric will be provided for each assessment.

Course Learning Outcomes

- CLO2 : Explain and interpret electrical and software models of biological signals.
- CLO3 : Evaluate the utility of instrumentation in measuring time-varying signals in biological applications.
- CLO4 : Acquire complex recordings of biological data using contemporary technologies.
- CLO5 : Process and analyse biological data using software engineering.
- CLO6 : Express findings from literature and one's own work using written communication

Detailed Assessment Description

Four lab assessments (in total 40%)

Week 7 - Laboratory 1: Physiological Signal Acquisition

Week 8 - Laboratory 2: Measurement using Oscilloscopes and Function Generators

Week 9 - Laboratory 3: Neural Electrical Activity

Week 10 - Laboratory 4: EEG Signal Analysis

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Quizzes

Assessment Overview

Three quizzes (10% each) will be conducted throughout the term. Each quiz aims to assess the learning progress from lecture materials and identify challenges that students may be facing. The quizzes will be delivered in-person using a range of question types and graded according to marking guidelines.

Course Learning Outcomes

- CLO1 : Explain the electrophysiology underlying biological signals.
- CLO2 : Explain and interpret electrical and software models of biological signals.
- CLO3 : Evaluate the utility of instrumentation in measuring time-varying signals in biological applications.
- CLO5 : Process and analyse biological data using software engineering.

Detailed Assessment Description

Five in-class assessments (in total 30%)

Week 1 - Quiz 1: Basic Electric Circuit and Differential Equation

Week 2 - Quiz 2: Electrophysiology

Week 3 - Quiz 3: Matlab - ECG simulation

Week 4 - Quiz 4: Matlab - Neural Modelling

Week 5 - Quiz 5: Matlab - Bio-signal Processing

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
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Final exam

Assessment Overview

The closed-book exam (total 30% weighting) will assess the following areas: Electrophysiology (8%), Engineering equivalence of bioelectronics (8%), clinically-used signals (6%), Theory under biological-signal analysis (8%). Question format will be combined by Multiple-choice (Electrophysiology, Bioelectronics), numerical/analytical computations (Engineering equivalence of bioelectronics/Biological signals), and open writing (Biological-signal analysis)

Course Learning Outcomes

- CLO1 : Explain the electrophysiology underlying biological signals.
- CLO2 : Explain and interpret electrical and software models of biological signals.
- CLO5 : Process and analyse biological data using software engineering.

Assessment Length

2 hour

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
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General Assessment Information

ALL assessments are in-class activity.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 2 June - 8 June	Lecture	Online lecture - Tuesday - Overview, basic quantities, circuit theory, differential equation revision.
	Tutorial	In-class Tutorial and Quiz-1 (Practice only) , circuit and differential equation (Thursday-Samuels 518, F25)
Week 2 : 9 June - 15 June	Lecture	Online lecture - Tuesday - Electrophysiology
	Tutorial	In-class Tutorial and Quiz-2, Biophysics (Thursday-Samuels 518, F25)
Week 3 : 16 June - 22 June	Lecture	Online lecture - Tuesday - Electrodes, Matlab for Biomedical engineers (fundamental)
	Tutorial	In-class Tutorial and Quiz-3, ECG simulation (Thursday-Samuels 518, F25)
Week 4 : 23 June - 29 June	Lecture	Online lecture - Tuesday - Bio-signal simulation in Matlab
	Tutorial	In-class Tutorial and Quiz-4, Neural activity modelling Matlab (Thursday-Samuels 518, F25)
Week 5 : 30 June - 6 July	Lecture	Online lecture - Tuesday - Bio-signal processing and analysis in Matlab
	Tutorial	In-class Tutorial and Quiz-5, Neural signal processing and analysis in Matlab(Thursday-Samuels 518, F25)
Week 7 : 14 July - 20 July	Laboratory	Lab and Assessment-1, Bio-signal acquisition (Thursday-Samuels 518, F25)
Week 8 : 21 July - 27 July	Laboratory	Lab and Assessment-2, Lab Electronics using Oscilloscope and signal generator (Thursday-Samuels 518, F25)
Week 9 : 28 July - 3 August	Laboratory	Lab and Assessment-3, Electrophysiological measurement (membrane potential) in different scales
Week 10 : 4 August - 10 August	Laboratory	Lab and Assessment-4, Bio-signal (EEG) processing and analysis

Attendance Requirements

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

General Schedule Information

Online Lectures will be in each Tuesday, and In-class Tutorial, Quiz, Lab and Assessment will be in each Thursday

Course Resources

Recommended Resources

- Have a ‘basic’ understanding of MATLAB and how to run the software. This is best achieved by completing the online MATLAB training, found at:

MATLAB Self-Paced Learning Modules.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Tianruo Guo				by appointment	No	Yes

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%) for that assessment item.

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

School Contact Information

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