BIOM9640

Biomedical instrumentation

Term 3, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Dr. David Tsai	d.tsai@unsw.edu.au	TBA	Rm1003, Lvl 1, Bioscience South (E26)	9065 8230

Lecturers

Name	Email	Availability	Location	Phone
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Dr. Tianruo Guo	t.guo@unsw.edu.au	TBA	Rm 515, Lvl 5, Samuels Building (F25)	

Demonstrators

Name	Email	Availability	Location	Phone
Mr. Grant Kelly	grant.kelly@unsw.edu.au	TBA	Lvl LG, Samuels Building (F25)	
Mr. Ashan Warnakulasuriya	a.warnakulasuriya@unsw.edu.au	TBA	Rm 506, Lvl 5, Samuels Building (F25)	
Dr. Jane Li	jingjing.li@unsw.edu.au	TBA	Rm514, Lvl 5, Samuels Building (F25)	

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 of bioelectric phenomena and neurostimulation. 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 medical instrumentation used clinically to perform these functions is also examined. This course has a focus on bioelectric phenomena, bioelectrodes, medical electronics and neurostimulation. The course includes a revision of DC and AC circuit theory, hands-on practice in the use and testing of medical transducers and electromedical equipment in common use in hospitals and research laboratories to make measurements of biomedical variables of clinical significance.

Course Aims

The aims of this course are to:

- introduce students to the fundamentals of electrical engineering as it relates to understanding bioelectric phenomena and neural stimulation
- understand the physical principles which govern the measurement of a biological variable or system by a transducer which converts the variable into an electrical signal
- understand various measurement devices and approaches including the underlying biological process that generates the quantity to be measured or controlled

Course Learning Outcomes

1. Identify the scope of biomedical instrumentation and its applications
2. Explain fundamental general transduction and biosensing principles
3. Discuss, develop and apply electrical engineering concepts and principles to a range of problems and medical applications
4. Critically review the literature in the area and use this knowledge to analyse simple biosensing and transduction problems
5. Summarise and communicate findings from literature research using oral and written methods

Teaching Strategies

BIOM9640 will use a combination of online (Moodle) lectures / tutorials and face-to-face laboratory classes.

Moodle will be used for file sharing, virtual classrooms, announcements and other communications. You are expected to check the platform regularly. In the first instance, you are encouraged to ask questions after lectures. Otherwise discussions and questions take place in the Discussion Forum in Moodle. Your demonstrators and academic staff will actively monitor these posts. If required, emails must be made from your student email address with BIOM9640 in the subject line.

This course consists of integrated lecture, tutorial and practical lab work. For the first half of the term

there will be a 3 hour period comprising a lecture and small group exercises/tutorials, group discussions and other methods to facilitate student learning. In the latter half of the term a set of laboratory experiments will be conducted to reinforce practical aspects of biomedical instrumentation and bioelectric phenomena. Problem solving is an essential component of this subject. A Moodle courseware module has been established for this subject (http://moodle.telt.unsw.edu.au). Upcoming tutorial tasks, discussion groups and lecture notes and resource materials will be made available on this site during the term. Please look at announcements on Moodle for last minute changes. Assessments and feedback on tutorial work will be regularly provided to the students.

This course requires you to understand the lecture material and then apply the knowledge to basic bioinstrumentation applications. It is important to understand the fundamental concepts as soon as possible and to ask for help if you do not understand. Attend all the lectures and if something is unclear, please ask questions. Make sure you review all the lecture notes and read all material that is suggested or handed out. Class participation through attendance at lectures and participation in class exercises and group work is expected and will allow for alternative methods of absorbing the relevant information.

The material is diverse and not as tightly linked into an overall analytical structure as in some other subjects. You will need to be prepared to assimilate facts relating to a large number of different measuring instruments and measurement principles. If you treat this assimilation simply as an exercise in rote learning, the volume of material will make it hard. If you become sufficiently involved and interested in the material, you will find it easy to comprehend; very much less rote learning will be needed because you will understand the principles and be able to work out the consequences.

Additional Course Information

Presumed knowledge

Some mathematics background is essential. You should have **prior exposure to complex numbers and algebra (equivalent to completion of 1st year mathematics – Maths 1A and 1B).** It is helpful but not essential that you have some knowledge of electrical circuits and systems. The essential circuits material will be reviewed during the course.

Relations to other BIOM courses

BIOM9640 consists of integrated lecture, tutorial and practical work and includes a major revision of electrical engineering knowledge as well as a focus on instrumentation and measurement relating to bioelectric phenomena. BIOM9650 (Biosensors and Transducers) runs in T1 and focuses on other sensing and transduction mechanisms (displacement, force, volume, pressure, flow, etc.) used for clinical measurements. Some of the basic electrical engineering fundamentals introduced in BIOM9640 will be assumed knowledge in BIOM9650.

The course BIOM9660 (Implantable Bionics), expands on aspects of electrical engineering circuits, bioelectrodes, biopotentials and neural stimulation from the perspective of designing and manufacturing an implantable therapeutic device. The course 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 BIOM9640 will assist in understanding these processes.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Tutorials, Hand in Questions	15%	Sep-22, Sep-29, Oct-6, Oct-13	1, 2, 3
2. Laboratory Attendance	10%	Weeks 7-10	2
3. Final Exam	40%	TBA (during exam period)	2, 3, 4
4. Major Laboratory Report	15%	TBA (after wk 10)	2, 4, 5
5. Quizzes	20%	Sep-29, Oct-13	1, 2, 3

Assessment 1: Tutorials, Hand in Questions

Due date: Sep-22, Sep-29, Oct-6, Oct-13

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 tutorials, students will use fundamental material from the lectures. Tutorials should be submitted on time through Moodle. Marks may be deducted for late submission without prior approval.

Related graduate capabilities include:

- Understanding of the discipline in its interdisciplinary context
- Rigorous in analysis, critique and reflection
- Able to apply knowledge and skills to solving problems

Assessment 2: Laboratory Attendance

Due date: Weeks 7-10

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 for completeness and consistency with a set of laboratory notebook guidelines that will be supplied to the student. The first laboratory involving using an oscilloscope is also assessable.

Assessment 3: Final Exam

Due date: TBA (during exam period)

The final exam may be made up of any of the following: true/false, multiple choice, matching, short answer and essay questions. The aims of this assessment are 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 is a direct test of the degree to which the knowledge-based learning outcomes listed above have been achieved. Further details on the final exam will be announced during the term.

Related graduate capabilities include:

- Understanding of the discipline in its interdisciplinary context
- Rigorous in analysis, critique and reflection
- Able to apply knowledge and skills to solving problems
- Capable of independent, self-directed practice

Assessment 4: Major Laboratory Report

Due date: TBA (after wk 10)

One laboratory will be chosen, and the student will be expected to prepare a formal laboratory report that will include results, discussion, error sources and reference to relevant literature. The objectives of the major report are to consolidate information learned in class and to develop critical data analysis and literature research skills. Details on how to complete the major lab report will be provided after week 7.

Related graduate capabilities include:

- Capable of independent and collaborative inquiry
- Capable of effective communication
- Information literate
- Enterprising, innovative and creative
- Collaborative and effective team workers
- Understanding of the discipline in its interdisciplinary context
- Rigorous in analysis, critique and reflection
- Able to apply knowledge and skills to solving problems
- Capable of independent, self-directed practice
- Capable of lifelong learning

Assessment 5: Quizzes

Due date: Sep-29, Oct-13

Two 20-min quizzes are scheduled through the term. Both consist of short answer questions and/or multiple-choice questions in a format similar to the final exam. The aims of these assessments are to encourage student revision during the course and to allow students to gauge their progress in different topics and receive feedback on that progress. These assessments are a direct test of the degree to which the knowledge-based learning outcomes listed above have been achieved. The quizzes will take place in Moodle, at the first 15-20 min of the weekly lecture timeslot. These will be invigilated through MS Teams video conferencing by your lecturers.

Related graduate capabilities include:

- Understanding of the discipline in its interdisciplinary context
- Rigorous in analysis, critique and reflection
- Able to apply knowledge and skills to solving problems
- Capable of independent, self-directed practice

Attendance Requirements

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 for completeness and consistency with a set of laboratory notebook guidelines that will be supplied to the student.

Course Schedule

View class timetable

Timetable

Date	Type	Content
Week 1: 12 September - 16 September	Lecture	Overview, basic quantities, circuit theory, complex number revision. [Blackboard Collaborate]
	Tutorial	DC circuits. [Blackboard Collaborate]
Week 2: 19 September - 23 September	Lecture	Basic quantities 2, transient response, passive filters. [Blackboard Collaborate]
	Tutorial	AC circuits. [Blackboard Collaborate]
Week 3: 26 September - 30 September	Lecture	Bode plots, opamps, feedback, active filters. [Blackboard Collaborate]
	Tutorial	Opamp and filters. [Blackboard Collaborate]
	Assessment	Quiz 1. [Moodle, MS Teams]
Week 4: 3 October - 7 October	Lecture	Instrumentation amps, noise, interference, excitable tissue. [Blackboard Collaborate]
	Tutorial	Amplification, excitable tissue. [Blackboard Collaborate]
Week 5: 10 October - 14 October	Lecture	Biopotentials, electrodes, and stimulation. [Blackboard Collaborate]
	Assessment	Quiz 2. [Moodle, MS Teams]
	Tutorial	Biopotential, electrodes. [Blackboard Collaborate]
Week 7: 24 October - 28 October	Laboratory	Laboratory 1 [Samuels 518]
Week 8: 31 October - 4 November	Laboratory	Laboratory 2 [Samuels 518]
Week 9: 7 November - 11 November	Laboratory	Laboratory 3 [Samuels 518]
Week 10: 14 November	Laboratory	Laboratory 4. [Samuels 518]

- 18 November		

Resources

Prescribed Resources

- All materials will be posted in Moodle

Recommended Resources

- Biomedical Transducers and Instruments, by T. Togawa, T. Tamura and P.Å. Öberg (CRC Press).
- Medical Instrumentation – Application and Design, edited by J.G. Webster (Houghton Mifflin). An excerpt from a chapter in a book titled “Physiological Measurement” will also be supplied.

Course Evaluation and Development

Anonymous student feedback on the course and the lecturers in the course is gathered periodically using the university's *myExperience* Process. Your feedback is much appreciated and taken very seriously. 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.

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.