BIOM9660 Bionics and Neuromodulation  
a.k.a. Implantable Bionics (pre-2019)  
Term 2, 2019

COURSE DETAILS

Units of Credit 6
Contact hours 3 hours per week lecture, 2 hours per week laboratory (see timetable in the Moodle portal at http://moodle.telt.unsw.edu.au)

Lecture Times and Venue  
Wednesdays 10AM – 1PM; Electrical Engineering G23

Laboratory Times and Venue  
Wednesdays 2PM – 4PM; Thursdays 12PM – 2PM; Fridays 10AM – 12PM and Fridays 1PM – 3PM  
Samuels Building, Level 5 Computer Lab (518)

Course Coordinator Dr Mohit Shivdasani  
Contact Details: m.shivdasani@unsw.edu.au  
9385 0561

Lab Demonstrators TBC

INFORMATION ABOUT THE COURSE

Welcome to “Bionics and Neuromodulation”. This course aims to provide students with the appropriate background theory and knowledge of therapeutic, bionic devices used to treat a range of disorders.

Australia has a rich history in bionics that can be traced back to the world's first attempt at an implantable “bionic eye” in the 1950's, world-leading cardiac pacemaker and defibrillator technologies in the 1960’s, to the remarkable cochlear implant in the 1970’s that has restored the sense of hearing to over a million people. The aim of this course is to pass along the knowledge and experiences from the people involved in the research and development of these devices to the students who we hope will form the next generation of biomedical engineers who will perpetuate Australia's leading role in the field of bionics.

By the end of the course you should have a fundamental understanding of the important factors that dictate the success or failure of neural interfaces and implantable electronics as well as the important factors surrounding design of non-implantable and minimally invasive bionic devices. You should also be qualified to advise on the choices available for a given therapeutic application and the advantages and disadvantages of each alternative.

It is natural for engineers from different disciplines to migrate to their 'comfort zone' when approaching the design of a medical implant. For instance, the electrical engineer will tend to concentrate on implant circuitry, the materials engineer is more likely to have an interest in implant packaging or electrode materials, the software engineer will really keep the end users in mind when designing the human machine interface and the chemical engineer will worry about the electrochemical reactions that occur as a result of electrical stimulation. This course is for biomedical engineers from various backgrounds and disciplines. An important objective of the course is to gain working knowledge of and confidence to operate in a broad range of topics within the field of implantable bionics, and to highlight the opportunities of working or conducting research in this field when the 'comfort zones' are broadened.

In this course we explore the types of bionic devices in clinical application and research including cochlear implants, bionic eyes, deep brain stimulation, spinal cord stimulation, peripheral nerve devices for modulating the nervous system as well as brain-machine interfaces. Key factors that determine the success or failure of devices will be studied, and fundamental theory and background knowledge will be conveyed through a series of lectures and laboratory exercises.
OBJECTIVES

The objectives of this course are to:

- introduce students to the fundamentals of bionic devices, their relation to understanding therapeutic sensory and functional neural stimulation as well as their ability to modulate the activity of neurons;
- understand the principles which govern the application of electrical neural stimulation and the design of instruments to be used for this purpose;
- understand various applications of therapeutic electrical neural stimulation including the underlying biological process that dictate the success or failure of such devices.

TEACHING STRATEGIES

This course consists of lectures and laboratory work. Each week there will be a lecture of up to three hours duration, and throughout the term the principles of the lecture will be reinforced through 2-hour laboratory sessions. Students will work on problems both individually and in groups.

Students enrolled in the course will be given access to a course module using UNSW Moodle (http://telt.unsw.edu.au/) where course material will be placed to comply with University policies. The primary contact method shall be via each student's university e-mail account. It is up to the student to ensure that their university e-mail account is maintained and checked regularly or forwarded to an e-mail account that is checked regularly. Assessments and feedback on work will be regularly provided to the students.

EXPECTED LEARNING OUTCOMES

During and on completion of this course, you as a student:

- will discover the scope of implantable and non-implantable bionics and its applications through a series of in-house and industry guest lectures
- should be able to explain the fundamental factors affecting electrical neural stimulation in a series of quizzes, laboratories and the final exam
- should be able to discuss, develop, collaborate and apply concepts and principles to a range of problems encountered in the laboratory sessions and the major assignment
- should be able to identify the complexities and specific challenges of life-long implantable device design through the knowledge gained in the lectures and experience gained in the laboratories
- will review the literature in the area and apply knowledge gained to plan and carry out experiments
- should be able to clearly summarise and explain findings from literature, course material, and one's own work using oral and written methods

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

- scholarly enquiry;
- engagement with the relevant disciplinary knowledge;
- critical thinking and creative problem solving; and,
- collaborative and multidisciplinary work.

They are also moderately related to:

- information literacy; enterprise, initiative and creativity.

For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

ASSESSMENTS

Before detailing the assessment items in this course, it is prudent to describe the philosophy of assessment that will be applied.
First, deadlines are deadlines, not guidelines or suggestions so the student is required to hand-in all assessments on-time if they expect to obtain credit for them. There are cases where legitimate and serious circumstances preclude one from accomplishing something by a particular time, but these are rare and obvious, and can be dealt with on a case-by-case basis provided formal special consideration requests are applied for in sufficient advance of the deadline.

Second, keeping up in this course is crucial. There is a great deal of material to cover, and a limited time in which to cover it. For this reason, assessment events will be frequent and so will require that the student stays on top of course material at all times throughout the term. If a lecture is missed, ensure that notes are obtained by other means. Slides for most lectures will be made available and, importantly, as in most circumstances this is not a competitive course (i.e. you will be assessed individually and not relative to others in the course), sharing of notes and open discussion of course material is encouraged, but unless otherwise stated, all work submitted for assessment must be your own, unique and original work. Failure to comply can result in a zero mark for the assessment task.

**Quizzes (20%)**:

After week one, a weekly quiz will be given in the remaining nine lecture sessions. These will be administered promptly at the start of the lecture period and will be of 15 minutes duration. Quizzes must be attended in class under examination conditions and only in exceptional circumstances will students be allowed to attempt a missed quiz on another scheduled day. Under no circumstances will an attempt be allowed without supervision. Students are expected to prepare for each quiz by studying the lecture and laboratory materials from the previous weeks. Short answer or multiple-choice questions will be the norm, and the aim will be to assess the student's understanding of the material as the course progresses.

Be advised that once a concept is introduced to the course, it may appear on any assessment event from that point onward. For instance, if a concept is introduced during week 1, a question on that concept could be on a quiz in week 7 (or any other week after week 1).

To compensate for the occasional mishap or unforeseen circumstance, the lowest score of the (up to) 9 quizzes will be excluded from the calculation of the overall quiz mark. The overall quiz mark will be calculated as follows:

(a) each quiz mark will be expressed as a percentage;
(b) all quiz marks with the exception of the lowest mark will be added together;
(c) the number calculated in (b) will be divided by one less than the total number of quizzes.

PLEASE NOTE: Item (b) above takes into account unforeseen circumstances. In other words, once during the term you may miss, fail or otherwise receive a poor mark on ONE AND ONLY ONE quiz and it will not count towards your overall mark in the course. If you miss, fail or otherwise receive a poor mark on any other quiz, it will count towards your mark and there is no avenue available that allows for a re-sit of a quiz. The quiz will remain open for a duration of 20 minutes to allow late attempts due to late arrival to class. However, it is in the best interests of the student to arrive on time for the quiz.

Quizzes are NOT returned to the students although the solutions will be worked through in the lecture in most cases (time permitting). This assessment is specifically linked to learning outcomes #1 and #2 above.

**Major Assignment (35%)**:

A comprehensive project (due in week#9) on the topic relating to sound processing in cochlear implants will form an integral requirement of the course. The details of this major assignment will be provided in the first few weeks of the course. This assessment is specifically linked to learning outcomes #1, #3, #5 and #6 above.

**Laboratories (10%)**:

A series of laboratory sessions will be conducted throughout the course in most weeks to perform practical experiments in groups of four to five students. These experiments are intended to complement and add to the concepts introduced in the lectures. Attendance and participation in the laboratory sessions will be marked. This assessment is specifically linked to learning outcomes #2-4 above.
Final Examination (35%):

At the end of the term, there will be a final written examination consisting of both qualitative and quantitative multiple choice, short- and long-answer questions. This assessment is specifically linked to learning outcomes #2, #4 and #6 above.

Throughout the course, 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 problems pertaining to bionics
- 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

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<tr>
<th>Assessment Task</th>
<th>Contribution to Mark</th>
<th>Comment</th>
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<tr>
<td>Quizzes (lowest score of all quizzes are disregarded)</td>
<td>20%</td>
<td>A quiz is scheduled at the beginning of most lectures after the first lecture. Each quiz will be comprised of short answer questions and/or multiple-choice questions.</td>
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<tr>
<td>Laboratory Attendance and Participation</td>
<td>10%</td>
<td>Each student will be required to attend (attendance marked), participate in the laboratory sessions and write down notes into a formal laboratory notebook. Most sessions will include group-based activities.</td>
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<tr>
<td>Major Assignment</td>
<td>35%</td>
<td>Each student will submit a Major Report on a topic relating to sound processing in cochlear implants including both, group and individual based activities and a short presentation. Details will be provided in the first few weeks of the course. The Major Report will be due at the end of Week #9.</td>
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<tr>
<td>Final Exam</td>
<td>35%</td>
<td>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.</td>
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COURSE PROGRAM

A detailed course program is provided at the top of the BIOM9660 Moodle portal to which all students have access via [http://moodle.telt.unsw.edu.au](http://moodle.telt.unsw.edu.au)

RELEVANT RESOURCES

UNSW Moodle will be used as the primary source of information and communication of marks and obligatory material that is required in order to comply with UNSW directives. This resource can be found here: [http://telt.unsw.edu.au/](http://telt.unsw.edu.au/)

Several useful references (books and journal articles) are available through the UNSW Library and others on-line. Of particular relevance to this course are:

- Implantable Neural Prostheses 1: Devices and Applications, edited by David Zhou and Elias


**DATES TO NOTE**

Refer to MyUNSW for Important Dates available at:

[https://my.unsw.edu.au/student/resources/KeyDates.html](https://my.unsw.edu.au/student/resources/KeyDates.html)

**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 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](https://student.unsw.edu.au/plagiarism). 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](https://student.unsw.edu.au/plagiarism)

**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: