Course Outline

BIOM4951/BIOM4952/BIOM4953/
BIOM9020/BIOM9021/BIOM9914

Biomedical Engineering Research Thesis and
Masters’ Project

Graduate School of Biomedical Engineering

Faculty of Engineering

Term 2 2020
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<td>Michael Stevens</td>
<td><a href="mailto:thesis.biomedeng@unsw.edu.au">thesis.biomedeng@unsw.edu.au</a></td>
<td>By appointment</td>
<td><a href="mailto:thesis.biomedeng@unsw.edu.au">thesis.biomedeng@unsw.edu.au</a></td>
</tr>
<tr>
<td>Course Convenor</td>
<td>Fatemeh Karimi</td>
<td><a href="mailto:thesis.biomedeng@unsw.edu.au">thesis.biomedeng@unsw.edu.au</a></td>
<td>By appointment</td>
<td><a href="mailto:thesis.biomedeng@unsw.edu.au">thesis.biomedeng@unsw.edu.au</a></td>
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2 Course information

<table>
<thead>
<tr>
<th>Element</th>
<th>Undergraduate (BIOM4951/BIOM4952/BIOM4953)</th>
<th>Postgraduate (BIOM9020/BIOM9021/BIOM9914)</th>
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<tr>
<td>Units of Credit</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>How many terms are required to complete this course</td>
<td>BIOM4951/BIOM4952/BIOM4953 are over 3 consecutive terms (4 UoC per term, called 4+4+4 model). Students have the choice of completing Thesis B and C together in one term (4 UoC in first term, 8 UoC in next term, called 4+8 model).</td>
<td>Masters of Biomedical Engineering by Coursework (Masters Project, 6 UoC per term) is over 2 consecutive terms (BIOM9020/BIOM9021). Masters of Biomedical Engineering by Coursework (full time) is over 1 term (BIOM9914 Masters Project).</td>
</tr>
<tr>
<td>Presumed Knowledge and Pre-requisites(s)</td>
<td>168 units of credit</td>
<td>WAM &gt; 65</td>
</tr>
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</table>

Teaching times and locations: None.

2.1 Course summary

The thesis provides an opportunity for the student to bring together engineering principles learned over their previous years of study and apply these principles to innovatively solve problems such as the development of a specific design, process and/or the investigation of a hypothesis. Thesis projects must be complex, open-ended problems that allow room for student creativity, and the acquisition, analysis and interpretation of results. There must be multiple possible solutions or conclusions at the outset and enough complexity to require a degree of project planning from the student. The thesis requires the student to formulate problems in engineering terms, manage an
engineering project and find solutions by applying engineering methods. Students also develop their ability to work in a research and development environment.

2.2 Course aims

The Biomedical Engineering Research Thesis or Masters’ Project aims to analyse or solve biomedical problems by applying engineering techniques. Problems to be addressed relate to basic or applied biomedical research or development of medical devices, processes or software. The Research Thesis is obligatory for all students of the dual (formerly concurrent) Bachelor of Engineering/Master of Biomedical Engineering program, and is undertaken in years 4 and 5 of the degree.

The Biomedical Engineering Masters Project is open to dual (formerly concurrent) degree students who have successfully completed Thesis A, B and C, or postgraduate students enrolled in the Masters of Biomedical Engineering by Coursework (Program code 8660).

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Develop a design or a process or investigate a hypothesis following industry and professional engineering standards. (7, 8, 9, 10)
2. Critically reflect on a specialist body of knowledge related to their thesis topic. (3)
3. Apply scientific and engineering methods to solve an engineering problem. (7)
4. Analyse data objectively using quantitative and mathematical methods. (2, 7, 8)
5. Demonstrate oral and written communication in professional and lay domains. (12)
6. To solve biomedical problems by applying 1-5.

2.4 Relationship between course and program learning outcomes and assessments

Table 1 shows the relationship between course and program learning outcomes.

<table>
<thead>
<tr>
<th>Course Learning Outcome (CLO)</th>
<th>LO Statement</th>
<th>Program Learning Outcome (PLO)</th>
<th>Related Tasks &amp; Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLO 1</td>
<td>Develop a design or a process or investigate a hypothesis following industry and professional engineering standards</td>
<td>7,8,9,10</td>
<td>Interim Report</td>
</tr>
<tr>
<td>CLO 2</td>
<td>Critically reflect on a specialist body of knowledge related to their thesis topic</td>
<td>3</td>
<td>Interim Report</td>
</tr>
<tr>
<td>CLO 3</td>
<td>Apply scientific and engineering methods to solve an engineering problem</td>
<td>7</td>
<td>Thesis</td>
</tr>
<tr>
<td>CLO 4</td>
<td>Analyse data objectively using quantitative and mathematical methods</td>
<td>2,7,8</td>
<td>Thesis</td>
</tr>
<tr>
<td>CLO 5</td>
<td>Demonstrate oral and written communication in professional and lay domains</td>
<td>12</td>
<td>Seminar, Conference Presentation, Thesis</td>
</tr>
</tbody>
</table>

### 2.5 Changes due to COVID-19

Due to the social distancing and travel restrictions in place because of COVID-19, for T2 all thesis work must be able to be completed remotely. This applies to all courses. You must speak with your supervisor to ensure your project can be completed remotely for Term 2.

### 3 Strategies and approaches to learning

#### 3.1 Learning and teaching activities

The student will rely on developing an independent and collaborative learning approach. Research questions are often open-ended and highly specialised, so the student will learn most by one-to-one mentoring provided by the supervisor and their research team.

You will learn most of your skills from PhDs and Post Docs in your lab. We encourage you to attend lab meetings to get and know lab personnel.

#### 3.2 Expectations of students

- Meet your supervisor regularly
- Complete all the assessments on time

### 4 Course schedule and structure

There is no official class time for this course. You must still ensure your enrolment and registration is up to date in your enrolment. Your face-to-face time needs to be organised with your supervisor, as you’re expected to meet them at least once per week.
5 Assessment - Undergraduate

Students in this cohort will complete their thesis over three terms (4+4+4) or over two terms (4+8). A summary of the assessment is as follows

**Thesis A:** It is intended that Thesis A cover the scoping, planning, and completing preparations for the project.

**Thesis B:** The primary intention behind Thesis B is to ensure students stay on track with their projects and project work as they progress through the year.

**Thesis C:** Thesis C continues the project work. The key deliverable is the Written Report, alongside a poster presentation.

Table 2 shows the assessment schedule over the three terms. These course assessments relate to the student’s research planning, conducting the research project and writing the thesis document, and disseminating the results in different forms.

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course Code</th>
<th>Task</th>
<th>Due Date</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomedical Engineering Research Thesis A</td>
<td>BIOM4951</td>
<td>TA1: Interim report</td>
<td>Mon Week 11 T2 (10 August 2020)</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TA2: Progress Report Checklist</td>
<td></td>
<td>SA/UN</td>
</tr>
<tr>
<td>Biomedical Engineering Research Thesis B</td>
<td>BIOM4952</td>
<td>TB1: Progress Research Seminar</td>
<td>T2 Week 10 (4+4+4) T2 Week 3 (4+8)</td>
<td>10%</td>
</tr>
<tr>
<td>Biomedical Engineering Research Thesis C</td>
<td>BIOM4953</td>
<td>TC1: Final Report</td>
<td>Mon Week 11 T2 (4+4+4)</td>
<td>65%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TC2: Conference Presentation</td>
<td>T2 Friday Week 10 (4+4+4) Online, asynchronous presentation</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TC3: Participation</td>
<td>T1 Week 11(4+4+4)</td>
<td>5%</td>
</tr>
</tbody>
</table>

*Table 2: Assessment Schedule for 2020 Term 2*
5.1 Thesis A (BIOM4951)

Your objectives in Thesis A are

1. To build your knowledge base on your specific research topic.
2. Use that knowledge base to inform your specific project aims and methodology.
3. Complete preliminary work towards meeting the specific project aims.

To assess this, there are two assessment tasks for Thesis A.

5.1.1 TA1: Interim report (10%)

1. Literature review or equivalent (50%)
   a. What is the problem to be solved, and its significance?
   b. Must include
      i. Brief background to project
      ii. Summary of literature relevant to project
      iii. Identification of “gaps” in the literature
      iv. Problem Statement (informed by gaps in the literature)
      v. Hypothesis and aims
   c. Indicative length is 10-15 pages,

2. Project planning (20%)
   a. How will the student answer the research question in the given time using their available resources?
   b. Must include
      i. Proposed Solution/Experimental Methodology
      ii. Detailed Thesis timeline – for next two terms
      1. Justification of time allocation for each task
      iii. Available resources identified
      iv. Required training and upskilling identified

3. Project Dependent Preparations (20%)
   a. Can the student achieve the aims in the timeline? What progress has been made already?
   b. Project specific, but may include
      i. Evidence of training on specific equipment
      ii. Evidence of some upskilling in new software/methods
      iii. Preliminary results
      iv. Preliminary sketches
      v. Components-parts ordered
      vi. Detailed budget of parts to be ordered
      vii. Risk Assessment

4. Document presentation (10%)
   a. Report layout
   b. English skills – spelling, grammar
   c. Data presentation (if applicable)
   d. Clarity of writing
   e. Citations consistent and correctly formatted

Note: For students intending to undertake Thesis B and C simultaneously in the second term (4+8 model), the Project Plan (Thesis A deliverable) should be of sufficient quality and depth to demonstrate capacity for the student to complete B & C concurrently.

5.1.2 TA2: Progress Checklist by Supervisor (SA/UN)

1. Feasibility of completion using 4+8 model
5.2 Thesis B (BIOM4952)

The primary intention behind Thesis B is to ensure students stay on track with their projects and project work as they progress through the year. What is completed in this time is project specific, but may include

5.2.1 Experimental Thesis
- Completing most/all experiments.
- Performing preliminary analysis.

5.2.2 Design Thesis
- Complete first and second rounds of designs and begin prototyping.
- Develop a final design for final manufacture.

There is one assessment task for Thesis B.

5.2.3 TB1: Research Seminar (10%)
- This seminar will be presented to the supervisor, their research team and an additional academic assessor. It will involve the student detailing the background, motivation for their work, progress completed so far and a critical reflection on their work.
- Students must organize a time with their supervisor and find second assessor.
- Students are responsible for sending out invites to supervisor and assessor.
- It will be presented online via Microsoft Teams.
- For students doing 4+4+4, there is an expectation that the student will have preliminary results by this point, and seminar will be in Week 10.
- For students doing 4+8, the results should be almost finalised by this point, and the seminar will be held in Week 3 of the second term. This gives students the opportunity to revert to 4+4+4 prior to Census Date if their progress is deemed unsatisfactory.
- Note: You should discuss with your supervisor early in the second term to identify a suitable time to complete the assessment task.
- Length: 15 minutes + 5 minutes questions

5.3 Thesis C (BIOM4953)

The aim of Thesis C is to finalise your research results and disseminate them in both an oral and written manner. This is the final key part of being a successful researcher. To that end, the assessment tasks provide students with a realistic experience of being a researcher.

There are 3 assessment tasks for Thesis C.

5.3.1 TC1: Written report (65%)
1. Literature review/background and putting the results in context (20%)
2. Execution of the research project, quality of analysis, discussion of results (50%)
3. Conclusions and value added (20%)
4. Document presentation (10%)

5.3.2 TC2: Conference Presentations (10%)
1. Students are required to present a short 6-7 minute conference presentation using VoiceThread at the end of term. This is a good opportunity to present your work to senior academics and to industry.
2. VoiceThread is an asynchronous presentation tool that enables you to upload your presentations slides, then record your voice explaining the motivations, findings, and significance of your results.
3. Your assessors will then post questions on your presentation that you must answer.
4. Success in this assessment will involve both a clear and cohesive presentation and an ability to explain your research to engineers who are not necessarily in your field of study.
5.3.3 TC3: Participation (5%)

1. Completion of Project Exit Form
2. Initiative and Engagement
   a. Intellectual contribution
3. Sustained activity throughout the term
   a. Attendance at lab meetings
4. Diligence and competence in performing the task
   a. Amount of work and engagement with problem
   b. Risk assessments complete (when relevant)
   c. Other project-specific evidence (e.g. lab book completion)

6 ASSESSMENT PROCEDURE: MASTERS’ PROJECT

Masters’ project assessment tasks are listed in Table 3 and Table 4. Note that for BIOM9020 and BIOM9021, the interim report contributes 20% of your final grade, and your final report contributes to 80% of your final grade.

Table 3: Assessment Tasks for Masters’ Project (BIOM9020/9021)

<table>
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<th>BIOM9021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task</td>
<td>Due Date</td>
</tr>
<tr>
<td>MP1: Interim report (20% of final Grade)</td>
<td>Mon Week 11 (10 August 2020)</td>
</tr>
</tbody>
</table>

Table 4: Assessment Tasks for 1-Term Masters’ Project (BIOM9914)

<table>
<thead>
<tr>
<th>BIOM9021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task</td>
</tr>
<tr>
<td>MP2: Final Report (100% of final grade)</td>
</tr>
</tbody>
</table>

6.1 BIOM9020 Assessment Details

6.1.1 MP1: Interim report

1. Reviewing the work of others (50%)
2. Articulating a research question and a plan (20%)
3. Project Dependent Preparations (20%)
4. Document presentation (10%)
6.2 BIOM9021 / BIOM9914 Assessment Details

6.2.1 MP2: Research Manuscript
The objective of this assessment is to create a research manuscript that could form the basis of a journal article. Please review the documents on Moodle for further instructions. Note that there is a strict word limit of 5000 words.

1. Literature review/background and putting the results in context (20%)
2. Execution of the research project, quality of analysis, discussion of results (50%)
3. Conclusions and value added (20%)
4. Document presentation (10%)

Note that for students enrolled in BIOM9020/9021, your grade on your transcript at the conclusion of BIOM9020 will read EC.

Further information
UNSW grading system: https://student.unsw.edu.au/grades
UNSW assessment policy: https://student.unsw.edu.au/assessment

7 ASSESSMENT DUE DATES FOR GSBME Term 2 2020

Table 5 summarises the assessment due dates for Term 2 2020

<table>
<thead>
<tr>
<th>Course</th>
<th>Assessment Item</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thesis A (BIOM9451)</td>
<td>Interim Report</td>
<td>Monday Week 11 (11:59pm)</td>
</tr>
<tr>
<td>Thesis B (BIOM4952)</td>
<td>Seminar</td>
<td>To be completed during Week 10 Term 2 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Arranged by student and supervisor)</td>
</tr>
<tr>
<td>Thesis C (BIOM4953)</td>
<td>Conference Presentation</td>
<td>Friday Week 10</td>
</tr>
<tr>
<td>Thesis C (BIOM4953)</td>
<td>Final Thesis</td>
<td>Monday Week 11 (11:59pm)</td>
</tr>
<tr>
<td>Thesis C (BIOM4953)</td>
<td>Exit Form</td>
<td>Friday Week 11</td>
</tr>
<tr>
<td>Masters Project Part 1 (BIOM9020)</td>
<td>Report</td>
<td>Monday Week 11 (11:59pm)</td>
</tr>
<tr>
<td>Masters Project Part 2 (BIOM9021)</td>
<td>Research Manuscript</td>
<td>Monday Week 11 (11:59pm)</td>
</tr>
<tr>
<td>Masters Project (BIOM9914)</td>
<td>Report</td>
<td>Monday Week 11 (11:59pm)</td>
</tr>
</tbody>
</table>
### 7.1 Submission of assessment tasks

Reports will be submitted via moodle.

### 8 Academic integrity, referencing and plagiarism

*Indicate the preferred referencing style with links to resources on how to use it.*

**Referencing** is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at [https://student.unsw.edu.au/referencing](https://student.unsw.edu.au/referencing)

**Academic integrity** is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others’ ideas should be appropriately acknowledged. If you don’t follow these rules, plagiarism may be detected in your work.

Further information about academic integrity and plagiarism can be located at:
- The Current Students site [https://student.unsw.edu.au/plagiarism](https://student.unsw.edu.au/plagiarism), and
- The ELISE training site [http://subjectguides.library.unsw.edu.au/elise/presenting](http://subjectguides.library.unsw.edu.au/elise/presenting)

The Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: [https://student.unsw.edu.au/conduct](https://student.unsw.edu.au/conduct).

### 9 Guidelines for writing your thesis (for BIOM4953 only)

The thesis content will be assessed according to the stated thesis aims which may be a) experimental or simulation based b) design or c) critical reviews. The assessment weightings are shown below. Please note that these are only assessment criteria. The thesis structure outline is entirely up to you as long as you clearly address the following:

1. **Introduction, background and aims**

   This will include i) the biomedical problems you are addressing and their relevance ii) past work addressing this problem and other relevant background information and iii) hypothesis and/or aims for this project.

2. **Methodology**

   a) Experimental or simulation based projects

   Detail the methods and techniques you used. Provide enough information so that others may replicate your methods. Explain how the methods were used to generate the data in this thesis.

---

Provide statistical methods if they were used to analyse data. Briefly explain how the methods address the hypotheses or aims of this project.

b) Design projects

Detail the software, instrumentation and manufacturing methods that were used to create the design. Provide a specification for the devices or software, as well as the intended methods for testing how well the design meets the specification. Provide statistical methods if they were used to analyse design performance.

c) Critical reviews

Outline the methodology that was used to critically review the field of research e.g., databases, interviews, patent searches

_Note: Sections 1 and 2 apply to both Interim Report and to Final Report._

3. Research Outcomes

a) Experimental or simulation based projects

Provide a summary of your results including statistical analysis. Clearly explain how your results were obtained using experimental methods. You will also need to submit the raw data to your supervisors (lab books, data files, etc). Note that you can submit additional data files (200MB limit)

b) Design projects

Provide designs as well as experimental or simulated data that tests how well the design meets specification. Provide a summary of your results including statistical analysis. Clearly explain how your results were obtained using experimental methods. You will also need to submit the raw data to your supervisors (lab books, data files, etc.). Note that you can submit additional data files (200MB limit)

c) Critical Reviews

Provide an in depth critical analysis of the field. The review will need to be an up to date and comprehensive analysis of all of the literature.

_Note: This section applies to final report, and to the interim report only if some preliminary work has been completed._

4. Discussion and Conclusions

a) Experimental or simulation based projects:

Critically evaluate the methods and results of your thesis. This includes comparing your results to those obtained in the literature. Interpret your data using statistical inference or simulation validation methods, discussing how well your research addresses stated aims and hypotheses and recommend future studies. Also comment on the novelty and utility of your research and its outcomes.

b) Design projects
Critically evaluate your design making reference to the design specification and measurement of performance. Compare your design with competing technologies. Where appropriate, note how well your devices or software has complied with industry standards, for example what testing would be required for registration by TGA or FDA. Also recommend future design improvements. Comment on the novelty and utility or your design. Is it worth patenting?

c) Critical reviews

Summarise the field making reference to gaps in knowledge that may be addressed by future research and development.

*Note: This section applies only to final report.*

5. References and Overall Presentation

Marks will be deducted for typographical errors, incorrectly labelled graphs, poor thesis structure, incorrect referencing etc.

*Note: This section applies to both Interim Report and to Final Report.*

### 10 Application for extension for undergraduate thesis courses

You can apply for special consideration when illness or other circumstances interfere with your assessment performance.

Other applications for extension of submission of thesis reports (e.g. equipment breakdown, etc.):

1. Discuss the possibility of an extension with your supervisor first.
2. Requests can then be lodged by the student here [http://tinyurl.com/yy2jzpyv](http://tinyurl.com/yy2jzpyv). The supervisor will then receive an email asking them to approve, before it is escalated to the decision panel.
3. Request must be lodged by Week 6 of term.
4. Panel decision will be made by end of Week 7.
5. The decision will be made by a panel – consisting of the HoS (or their nominee), Thesis Coordinator, and 1 other person.
6. Students should be alerted to the fact that this is not guaranteed, and thus should not rely on getting an extension.
7. Typically, extensions are granted UP TO 3 weeks. The length of the extension needs to be requested and justified by the supervisor. Panel will decide the length of time granted.

### 11 Application for extension for masters’ project

You can apply for special consideration when illness or other circumstances interfere with your assessment performance.

Other applications for extension of submission of thesis reports (e.g. equipment breakdown, etc.):

1. Discuss the possibility of an extension with your supervisor first.
2. Requests can then be lodged by the student here [http://tinyurl.com/yy2jzpyv](http://tinyurl.com/yy2jzpyv). The supervisor will then receive an email asking them to approve, before it is escalated to the decision panel.
3. Request must be lodged by Week 6 of term.
4. The decision will be made by the Thesis Coordinator
5. Students should be alerted to the fact that this is not guaranteed, and thus should not rely on getting an extension.
6. Typically, extensions are granted UP TO 3 weeks. The length of the extension need to be requested and justified by the supervisor.

12 Procedure if you fail Thesis A, B or C

Fail in Thesis A (interim report mark < 50%) – must re-enrol in Thesis A again.
Fail in Thesis B (seminar mark < 50%) – must re-enrol in Thesis B again

Fail in Thesis C – Students have three options.

1. re-enrol for Thesis A, B and C again, new project and supervisor
2. re-enrol for Thesis C again, same project - needs consent of an appropriate supervisor & student
3. Student does further work, re-submits thesis after a max of 6 weeks. Course mark capped at 50%. If still not satisfactory, then needs to re-enrol.

This last option is only available if the original mark was ≥40, OR if the student is in their last semester before graduation (regardless of the original mark).

Fail in Thesis B & C (when taken simultaneously) – Students must re-enrol in Thesis B again, and cannot concurrently enrol in C. They can then take Thesis C when Thesis B has been satisfactorily completed

13 Late procedure

In all cases, applications for late submission can be applied for BEFORE the due date. This is at the discretion of the thesis coordinator but should only be granted in exceptional circumstances. As per normal, students can also apply through myUNSW for special consideration.

For Thesis A, B or C, 5 marks will be deducted off the thesis for every day late. Penalty applies until the marks for the course decrease to 50, and further lateness does not result in failure of the course, but might be a failure of the thesis (weekends count as days).

14 Industry based projects

We encourage students to seek partnerships with industry, so students can have a co-supervisor from industry. However, if confidentiality is required, a confidential disclosure agreement (CDA) is obligatory. The agreement will protect the intellectual property rights of the industry partner, UNSW and the student. Students or academics are not authorised to sign confidential disclosure agreements on behalf of UNSW and are advised to talk to the course coordinator and UNSW legal office to arrange for drafting and signing of the confidential disclosure or research agreement.

15 Relevant resources

All material will be provided via Moodle
16 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 Course and Teaching Evaluation and Improvement (CATEI) process.

17 Dates to note

Refer to MyUNSW for Important Dates.

18 Administrative matters

Include information on:

School/Faculty office

Website where student related information, policies and guidelines are available

19 Additional support for students

- The Current Students Gateway: https://student.unsw.edu.au/
- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- Student Wellbeing, Health and Safety: https://student.unsw.edu.au/wellbeing
- Disability Support Services: https://student.unsw.edu.au/disability-services
- UNSW IT Service Centre: https://www.it.unsw.edu.au/students/index.html